

Clean Version of  
First Amended Complaint  
With Exhibits 1 - 5

**UNITED STATES DISTRICT COURT  
SOUTHERN DISTRICT OF NEW YORK**

PHUNWARE, INC.,

Plaintiff,

- against -

UBS SECURITIES LLC,

Defendant.

Civil Action 1:23-cv-06426-DEH

**FIRST AMENDED COMPLAINT**

**JURY TRIAL DEMANDED**

## TABLE OF CONTENTS

I.	SUMMARY OF CLAIMS .....	1
II.	JURISDICTION AND VENUE.....	4
III.	THE PARTIES .....	4
	A. Plaintiff .....	4
	B. Defendant.....	5
IV.	PHUN’S BUSINESS.....	6
V.	DEFENDANT’S MANIPULATIVE SPOOFING SCHEME.....	7
	A. Spoofing Is A Form Of Market Manipulation .....	7
	B. Defendant Engaged In Manipulative Spoofing Of PHUN.....	10
	1. Example Episode: April 27, 2021 at 09:30:35.551829 .....	14
	2. Example Episode: October 26, 2021 at 09:30:04.427209 .....	16
	3. Example Episode: October 27, 2021 at 09:30:36.323727 .....	17
	4. Example Episode: October 28, 2021 at 09:31:29.737682 .....	19
	5. Example Episode: November 08, 2021 at 09:31:10.819250 .....	20
	6. Example Episode: March 15, 2023 at 09:30:20.706990 .....	22
	C. Defendant Intentionally Hid Its Manipulative Spoofing Scheme .....	24
	D. Defendant’s Transactions In PHUN Are Not Legitimate Market Making Activity .....	24
	E. Defendant Acted With Scienter .....	27
	F. Loss Causation And Standing .....	32
	1. January 26, 2021 .....	45
	2. October 26, 2021.....	47
	3. February 12, 2021 .....	50
VI.	THE MARKET FOR PHUN WAS EFFICIENT DURING THE RELEVANT PERIOD .....	53
VII.	CLAIMS FOR RELIEF .....	54
	A. First Claim for Relief for Spoofing in Violation of Section 10(b) of the Exchange Act of 1934 and Rule 10b-5(a) and (c) Promulgated Thereunder.....	54
	B. Second Claim for Relief for Spoofing in Violation of Section 9(a)(2) of The Securities Exchange Act of 1934.....	55
	C. Third Claim for Relief for New York Common Law Fraud.....	56
	D. Fourth Claim for Injunctive Relief.....	56
VIII.	PRAYER FOR RELIEF .....	57
IX.	DEMAND FOR JURY TRIAL .....	57

Plaintiff Phunware, Inc. (“PHUN” or “Plaintiff”), by and through its undersigned attorneys, Cohen Milstein Sellers & Toll PLLC, and for its complaint against UBS Securities LLC (“UBS”), alleges upon personal knowledge, information and belief, and an investigation by counsel as follows:

**I. SUMMARY OF CLAIMS**

1. This case arises from Defendant UBS’s scheme to manipulate PHUN’s share price during the period of January 5, 2021 to March 15, 2023 (the “Relevant Period”). Throughout the Relevant Period, Defendant deliberately engaged in repeated spoofing that interfered with the natural forces of supply and demand, and repeatedly drove PHUN’s share price downward. Defendant’s manipulation violates Section 10(b), Rule 10b-5 and Section 9(a)(2) of the Securities Exchange Act of 1934, and constitutes fraud under New York state common law.

2. PHUN is a publicly-traded technology company that was founded in 2009, at a time when nearly every large enterprise business was starting its digital transformation – computing was transitioning to the cloud, application consumption was transitioning to mobile, and software was transitioning to a Software as a Service (“SaaS”) model. PHUN was created to focus on one of the largest and most strategic opportunities in information technology: to provide enterprises a comprehensive software program that could engage, manage, and monetize customer experiences over mobile devices, directly improving business results and revenues for these companies on a worldwide basis.

3. PHUN is the pioneer of Multiscreen-as-a-Service (“MaaS”), a fully integrated enterprise cloud platform for mobile that provides companies the products, solutions, data and services necessary to engage, manage and monetize their mobile application portfolios and audiences globally at scale.

4. PHUN went public in December 2018. It is traded on the Nasdaq under the symbol PHUN. Since going public, PHUN has grown dramatically. At scale, PHUN has managed over 2 billion Phunware IDs, created to identify unique mobile devices visible on its network of applications, across more than 5,000 mobile application portfolios for more than 1 billion monthly active devices across more than 1 trillion database events. PHUN's products and services have been used by many of the world's leading brands in virtually every industry, including PwC, Intel, AT&T, Cisco, CBS, Mount Sinai, NYU Langone Health, VHC Health, Marriott, Atlantis Paradise Island Bahamas, Lowe's, Oprah, NFL, and NASCAR.

5. Analysts uniformly and consistently recommended PHUN to investors throughout the Relevant Period. All four of the firms following PHUN assigned it "Buy" ratings at all points during the Relevant Period, with price targets that were typically over \$2 and reached as high as \$6 – levels considerably higher than the actual prices at which PHUN traded.<sup>1</sup> This discrepancy continues to the present, with analysts' current price targets exceeding PHUN's current share price by over 300%.

6. That PHUN's stock price has not followed the market's expectation is not by chance. Rather, it is the result, in significant part, of Defendant's spoofing.

7. Spoofing is a form of market manipulation that, in this case, was accomplished by placing "Baiting Orders" in the Limit Order Book<sup>2</sup> that are not intended to be executed and have no legitimate economic purpose. The purpose of these Baiting Orders is to create a false illusion

---

<sup>1</sup> One of these analysts, Taglich Brothers, has rated PHUN as a "Speculative Buy" during the Relevant Period.

<sup>2</sup> A "Limit Order Book" is an electronic list of buy and sell orders for specific securities and other financial instruments that is organized by price levels and lists the number of shares being bid or offered at each price point. The Limit Order Book reflects whether the market price for the security is moving upwards or downwards and is visible to every trader on the exchange.

of market interest (either positive or negative) that will generate a response from other market participants that the spoofers can use to their advantage. For example, if the goal of the spoofing scheme is to drive the price down, the spoofer enters Baiting Orders to sell, to create an appearance of a downward trending market, which will then bait other market participants into entering their own sell orders to minimize or avoid suffering losses. Shortly thereafter, the spoofer will place orders to buy, or “Executing Purchases,” which are intended to be executed against the other market participants’ sell orders at the lower artificial prices prompted by the false Baiting Orders to sell. Immediately after placing these Executing Purchases to buy, the spoofer then cancels all of the Baiting Orders to sell, which completes the profitable spoofing cycle.

8. This scheme can be used multiple times during a trading day, and then repeated throughout a protracted trading period. To maximize the speed of their market access and execution of their trading strategies, spoofers typically utilize algorithmic trading programs through high-frequency trading computer systems which enable thousands of Baiting Orders to be placed in a matter of seconds and sometimes milliseconds.

9. During the Relevant Period, Defendant engaged in spoofing to manipulate the price of PHUN shares on Nasdaq, thus creating an imbalance in the market for PHUN shares and inducing other market participants to buy or sell at artificial prices. In order to carry out its spoofing scheme, Defendant placed over 82 million Baiting Orders and purchased over 640,000 PHUN shares in over 1,000 executed orders at manipulated prices during the Relevant Period.

10. PHUN sold over 40 million shares at manipulated prices as a result of Defendant’s actions. By repeatedly and brazenly manipulating the market through its spoofing, Defendant directly impacted the price of PHUN’s shares in the market, causing PHUN significant losses as it sold millions of shares of its stock at artificially depressed prices.

## **II. JURISDICTION AND VENUE**

11. This Court has jurisdiction over the subject matter of this action pursuant to Section 27 of the Exchange Act, 15 U.S.C. § 78aa and 28 U.S.C. § 1331. This Court also has jurisdiction over the state law claims under 28 U.S.C. § 1367 because those claims are so related to the federal claim that they form part of the same case or controversy.

12. This Court has personal jurisdiction over Defendant. Defendant maintained its principal place of business in this District, conducted a substantial part of the events asserted in this complaint in this District, and directed its fraudulent activity into this market by manipulating PHUN stock on Nasdaq, which is located in this District. The unlawful acts committed by Defendant had a direct and substantial impact on the market price of PHUN shares traded in this District in the United States.

13. Venue is proper in the Southern District of New York pursuant to 28 U.S.C. § 1391 and Section 27 of the Exchange Act, in that many of the acts, transactions and occurrences alleged herein occurred in this District, and Defendant conducted business here in connection with the events described herein. Defendant directly or indirectly made use of the means or instrumentalities of interstate commerce including the mails in connection with the conduct alleged herein.

## **III. THE PARTIES**

### **A. Plaintiff**

14. Plaintiff PHUN is a publicly traded company with a market capitalization of approximately \$52 million as of the filing of this Complaint, whose shares trade in New York on Nasdaq. During the Relevant Period, PHUN sold over 40 million shares of its stock at depressed prices as a result of Defendant's illegal manipulation.

**B. Defendant<sup>3</sup>**

15. UBS Securities LLC is a Delaware limited liability company with its principal place of business at 1285 Avenue of the Americas, New York, New York 10019. UBS is a registered broker-dealer that executes securities transactions on various trading venues in the U.S.

16. Among other regulatory actions, in 2018, UBS AG (the parent company of UBS Securities LLC) agreed to pay \$15 million to resolve claims by the Commodity Futures Trading Commission (“CFTC”) which found that UBS AG for at least 5 years attempted to manipulate the price of precious metals futures contracts by using various methods of spoofing techniques.<sup>4</sup> Notably, this settlement also required UBS AG to maintain and implement training programs, systems, and control to detect and deter spoofing by its personnel.

17. Similarly, in 2012, UBS AG was ordered by the CFTC to pay a \$700 million penalty to settle charges that it manipulated certain global benchmark interest rates. Specifically, the CFTC found that UBS “brazenly game[d] some of the world’s most important financial benchmarks” by, for at least six years, regularly trying to manipulate multiple benchmark interest rates for profit, succeeding in manipulating the official fixing of Yen LIBOR, colluding with other LIBOR panel banks to spread false information, and making false U.S. Dollar LIBOR and other submissions to protect its reputation during the global financial crisis. The CFTC concluded that UBS’s “unlawful conduct . . . undermined the integrity of the London Interbank Offered Rate

---

<sup>3</sup> Whenever reference is made to any act, device, contrivance, or scheme to manipulate PHUN securities by Defendant, the allegation is intended to also include the subsidiaries, affiliates, sister companies, agents and representatives of Defendant, whose identities and specific involvement in this market manipulation case are unknown to Plaintiff at this time. Only after discovery is taken will their identities and involvement become known.

<sup>4</sup> “CFTC Orders UBS to Pay \$15 Million Penalty for Attempted Manipulation and Spoofing In the Precious Metals Futures Markets,” CFTC Website (Jan. 29, 2018), available at <https://www.cftc.gov/PressRoom/PressReleases/7683-18> (last visited July 25, 2023).



(“LIBOR”), the Euro Interbank Offered Rate (“Euribor”), the Euroyen Tokyo Interbank Offered Rate (“Euroyen TIBOR”), and other interest rate benchmarks.”<sup>5</sup> For the same misconduct, UBS AG was ordered to pay the U.K. Financial Services Authority \$259 million, the Swiss Financial Markets Authority \$64 million, and over \$400 million to resolve criminal claims.<sup>6</sup>

18. UBS conducted continuous activity in New York, directly related to the claims in this action, by employing high speed algorithmic computer systems to route orders and execute trades of PHUN shares throughout the U.S., including in New York, on Nasdaq.

19. The spoofing activity that forms the basis of the claims in this action may have been executed by Defendant for its own account, for which it acted as a dealer, or for client accounts, for which it acted as a broker. In either scenario, Defendant’s spoofing activity is in violation of the federal securities laws.

#### **IV. PHUN’S BUSINESS**

20. PHUN helps the world’s most respected brands create category-defining mobile experiences. PHUN helps brands define, create, launch, promote, monetize and scale their mobile identities as a means to anchor the consumer journey and improve brand interactions.

21. PHUN pioneered Multiscreen-as-a-Service, a fully integrated enterprise cloud platform for mobile that provides companies the products, solutions, data and services necessary to engage, manage and monetize their mobile application portfolios and audiences globally at scale.

22. This MaaS platform provides the entire mobile lifecycle of applications through

---

<sup>5</sup> CFTC Website (December 19, 2012), available at <https://www.cftc.gov/PressRoom/PressReleases/6472-12> (last visited July 25, 2023).

<sup>6</sup> Office of Public Affairs, USDOJ Website (Dec. 19, 2012), available at, <https://www.justice.gov/opa/pr/ubs-securities-japan-co-ltd-plead-guilty-felony-wire-fraud-long-running-manipulation-libor> (last visited July 25, 2023).

one procurement relationship. PHUN's MaaS platform allows for the licensing and creation of category-defining mobile experiences for customers and their application users worldwide.

23. PHUN's products and services include cloud-based mobile software licenses, analytics that provide data related to application use and engagement, content management, marketing automation, advertising, location services, and a range of cloud-based vertical solutions for healthcare, retail, sports, travel, real estate, and other industries.

24. PHUN's early business success led to an ever-growing list of industry awards, including being named by USA Today as an Entrepreneur of the Year Finalist in 2014, being named by Forbes as one of America's Most Promising Companies in both 2014 and 2015, being named by Deloitte as one of its Technology "Fast 500" companies from 2014-2016, and being named by Corporate Vision Magazine as the Best Mobile-Driven Enterprise Cloud Platform.

25. The global business world took notice and PHUN counts among its customers many of the top brands in the world, including Kaiser Permanente, the Mayo Clinic, Warner Bros., NBC Sports, AMC, ESPN, Intel, and PwC.

26. At scale, PHUN's platform has reached about 1 in 10 mobile devices globally, processing over 6 billion transactions every day.

27. The illegal market manipulation of PHUN stock by Defendant has significantly impaired the ability of Plaintiff to raise funds from the public markets at valuations that reflect its true market value, and will continue to impact the ability of PHUN to raise such funds or obtain and retain customers in the future.

## **V. DEFENDANT'S MANIPULATIVE SPOOFING SCHEME**

### **A. Spoofing Is A Form Of Market Manipulation**

28. There are three well established economic assumptions that animate securities

markets: (i) all else being equal, increased supply decreases prices and increased demand increases prices; (ii) a security's share price accurately reflects the security's value at that point in time based on the public information available to the market; and (iii) the quotes and orders published in the market reflect legitimate trading interest.

29. Spoofing is an insidious form of market manipulation that undermines the integrity and stability of securities markets by taking advantage of these three economic assumptions to artificially and illegally move the market price of a security either upwards or downwards.

30. Specifically, a market participant, often utilizing high-frequency trading computer systems that operate algorithmic trading programs to maximize the speed of their market access and the execution of their trading strategies, creates a false illusion of excess supply or demand by placing Baiting Orders into a Limit Order Book that are not intended to be executed and have no legitimate economic purpose. These Baiting Orders are entered into the Limit Order Book to create an illusion of market interest intended to generate a response from other market participants to follow the artificial selling or buying trend that the Baiting Orders created.

31. A legitimate trader buys when it thinks the price of a security is likely to go higher and sells when it thinks the price of a security will go lower. One of the tell-tale signs of a manipulative spoofer is a rapid reversal of trading direction—a lot of sell orders, followed by buy orders, followed by the cancellation of sell orders—which suggests that the original sell orders were not intended to be executed, but were merely a ploy to drive the price down to “buy low.” Defendant engaged in this distinctive manipulative spoofing pattern again and again during the Relevant Period.

32. Thus, if the spoofer's goal is to drive the price down, the spoofer enters Baiting Orders to sell, which are intended to “bait” or “trick” investors into entering their own sell orders

to minimize or avoid suffering losses in a downward trending market. Shortly after the spoofer places the Baiting Orders to sell, and after those Baiting Orders have lured unsuspecting traders into placing their own orders, the spoofer places orders to buy, or “Executing Purchases,” on the opposite side of the Limit Order Book. These Executing Purchases to buy are intended to be executed at the artificially low prices generated by the Baiting Orders to sell. Immediately after executing the Executing Purchases to buy in the Limit Order Book, the spoofer cancels all of the Baiting Orders to sell, which completes the spoofing cycle.

33. In short, manipulative spoofing can be seen as high-speed bluffing, in which the spoofer deceives unsuspecting traders into transacting at artificially high or low prices. For example, a spoofer could place Baiting Orders to sell a big block of shares at \$10, when the last sale was at \$10.03. After other sellers rush to match the lower price, the spoofer would quickly pivot, cancel their sell order, and then place Executing Purchases at the \$10 price they generated with the Baiting Order. This scheme can be used multiple times during a trading day, and then repeated throughout a protracted trading period, as it was here.

34. In the SEC’s “Staff Report on Algorithmic Trading in U.S. Capital Markets,” dated August 5, 2020, the SEC discussed spoofing, describing it as “the submission and cancellation of buy and sell orders without the intention to trade in order to manipulate other traders” and calling it a “harmful strategy” employed by some high-frequency traders. The SEC further stated that spoofing was carried out by “strategically plac[ing] spoofing orders to create the impression of substantial order book imbalances in order to manipulate subsequent prices,” and noted that “stocks targeted for spoofing had higher return volatility, lower market capitalization, lower price level, and lower managerial transparency.”

35. The persistence of the price impact of manipulation is well-established in the

market microstructure literature. As Nobel prize-winning economist Professor Paul Milgrom has explained: “Because manipulative trades are viewed by market participants as potentially informed, and potentially informed trades can result in permanent price impact, *manipulative trades can lead to permanent price impact.*”<sup>7</sup> Based on an extensive review of the literature, Dr. Milgrom gives two reasons for why market participants cannot readily identify manipulative trades: *First*, it is highly improbable that manipulative trades can immediately be identified as manipulative and uninformed by market participants. For any agent in the market, the incentive to gather private information—and thus to become an informed trader—is directly related to the volume of its trades and the size of its positions. The Defendant here is among the largest market participants and has powerful incentives to be well-informed. Other participants would likely expect this, and therefore have good reason to treat their trades as potentially informed. This tendency of large traders to be well informed is also observed by others in the market microstructure literature. *Second*, it is also improbable that the public will eventually come to know which trades were manipulative and uninformed. For all these reasons and others, Professor Milgrom concluded, “The market microstructure literature demonstrates clearly how potentially informed trades can result in permanent price impact.”

**B. Defendant Engaged In Manipulative Spoofing Of PHUN**

36. Trading records detailed in Exhibit 1 hereto, demonstrate that Defendant placed tens of millions of Baiting Orders to sell PHUN shares during the Relevant Period.<sup>8</sup> The spoofing

---

<sup>7</sup> Expert Report of Professor Paul Milgrom, *Alaska Electrical Pension Fund v. Bank of America*, Case No. 14-cv-7126 (JMF) ECF No. 551 (S.D.N.Y.) (Jan. 22, 2018) (attached hereto as Ex. 3).

<sup>8</sup> The data utilized by Plaintiff to support the allegations in this Complaint consist of the complete stream of deanonymized order book messages on the Nasdaq market, including cancellations and executions, provided directly by Nasdaq. As only a fraction of order flow in PHUN’s shares is deanonymized, Plaintiff believes that additional spoofing activity is likely to be revealed through discovery.

scheme perpetrated by the Defendant was intended to, and did, drive PHUN's market price downward so that Defendant could purchase PHUN shares at artificially lower prices. This scheme was accomplished through the following three stages:

37. First, Defendant flooded the markets with large quantities of Baiting Orders to sell during the "Baiting Period." These orders had no legitimate purpose and when placed, were not intended to be executed. The sole purpose for the placement of these Baiting Orders to sell was to deceive and mislead market participants into believing that the market price of PHUN's stock was moving downward.

38. Second, shortly after the Baiting Orders to sell were placed in the Limit Order Book, Defendant placed its Executing Purchases on the opposite side of the Limit Order Book to purchase PHUN shares at the lower stock prices created by the downward manipulation of its Baiting Orders.

39. Finally, immediately after the completion of its Executing Purchases to buy PHUN shares at the lower prices, Defendant cancelled and removed all of its Baiting Orders to sell from the Limit Order Book.<sup>9</sup>

40. This spoofing pattern was repeated by Defendant multiple times a day and continuously throughout the Relevant Period. Defendant engaged in this distinctive spoofing pattern, each individually a "Spoofing Episode," again and again, many multiple times a day and continuously throughout the Relevant Period—and at multiples of the average trader—resulting in large profits. Specifically, during the Relevant Period, Defendant submitted at least 82,717,302 shares of fictitious Baiting Orders on Nasdaq.

---

<sup>9</sup> The terms "cancel" or "cancellation" in this Complaint refer to the deletion of an order from a Limit Order Book, as well as a modification of an order or quote on a Limit Order Book which results in reduction in the volume of shares displayed in that order or quote.

41. As it intended, Defendant's Baiting Orders led to a substantial sell-side imbalance in the Defendant's order flow at the time of Executing Purchases, successfully creating artificial selling pressure in the market and inducing other unknowing market participants to submit additional sell orders and artificially drive down the price of PHUN shares.

42. As reflected in Exhibit 1, Defendant then took advantage of the artificially depressed price of PHUN shares it created by placing Executing Purchases to purchase a total of 647,119 shares below the prevailing best offer prior to entry of the Baiting Orders, pocketing the difference. Almost immediately thereafter, Defendant then cancelled all of its fictitious Baiting Orders.

43. Specifically, Defendant submitted 82,717,302 shares of Baiting Orders to sell, and purchased 647,119 shares in 1,021 distinct Executing Purchases at prices depressed by these Baiting Orders, leading to an average price decline of -7.60% per purchase.

44. Notably, while engaging in spoofing activity, Defendant submitted significantly more sell-side share orders per each Executing Purchase than for non-spoofed executed purchases. During the Baiting Periods, Defendant submitted new sell-side orders for a median of 19,584 shares per Executing Purchase. During the same time window prior to non-spoofed executed purchases, market participants submitted a median of 4,500 shares in new sell-side orders per purchase. In other words, Defendant's ratio of sell-side orders per executing purchase was more than **4 times** that of non-spoofed executed purchases.

45. Similarly, Defendant cancelled significantly more sell-side orders than after non-spoofed executed purchases. During the Cancellation Period following the Executing Purchases, Defendant cancelled a median of 19,584, or 100%, of the created volume of 19,584 sell-side shares. By contrast, during the same time window as the Cancellation Period following non-spoofed

executed purchases, market participants cancelled a median of 500, or 11.11%, of the 4,500 sell-side shares created before the purchase. In other words, Defendant's sell-side cancellation volume following spoofed purchases was **39 times** that of non-spoofed executed purchases.

46. In other words, when spoofing the market, Defendant injected more artificial sell-side order flow than non-spoofed orders prior to buying shares, as measured by (1) the volume of sell side order flow (more than 4 times higher); (2) the cancellation of that order flow (39 times higher); and (3) the greater share of cancelled sell-side order flow (100% vs. 11.11%).

47. The placement and cancellation of Baiting Orders to sell by Defendant throughout the Relevant Period operated as a manipulative fraud on the market. The Baiting Orders were intended to mislead other market participants into believing that the downward movement of PHUN's share price was being caused by the natural forces of supply and demand. The placement and cancellation of thousands of Baiting Orders by Defendant was not in furtherance of any legitimate purpose. Rather, these activities were intended to send false and misleading pricing signals to the market to trick or bait market participants into executing their own sell orders. This created a "pile-on" effect which drove down PHUN's share price even further, thereby enabling Defendant to purchase PHUN's shares at artificially manipulated lower prices.

48. The following are examples of specific spoofing activities by Defendant during the Relevant Period. These examples are based on detailed deanonymized trading records from Nasdaq that reflect the interplay between the Baiting Orders and Executing Purchases and how Defendant manipulated downward the market price of PHUN shares on Nasdaq. Defendant's relentless and repetitive spoofing activities throughout the Relevant Period caused sustained declines in the market price of PHUN shares from which it did not recover during the Relevant Period. Exhibit 1 to this Complaint contains a comprehensive list of de-anonymized Spoofing



Episodes and spoofing activity by Defendant, along with the volume and prices of Baiting Orders, Executing Purchases and the price impact of such spoofing activity, during the Relevant Period.

**1. Example Episode: April 27, 2021 at 09:30:35.551829**

49. On April 27, 2021 at 09:30:35.551770181, the national best bid and offer for PHUN stock was a bid to purchase 6 shares at a price of \$1.63 per share and an offer to sell 59 shares at a price of \$1.64 per share.

50. From 09:30:00.528225910 to 09:30:35.551829, Defendant placed 404,486 shares of Baiting Orders at prices ranging from \$498.00 to \$1.70 per share.<sup>10</sup> As of 09:30:35.551829, the submission of these Baiting Orders left Defendant with an imbalanced order book position favoring the sell side among attributed Nasdaq orders. As calculated by Plaintiff, this order book position consisted of bids to purchase 47,285 shares at prices ranging from \$0.45 per share to \$1.63 per share, and an offer to sell 404,386 shares at prices ranging from \$1.70 per share to \$4.28 per share.

51. Between 09:30:35.551829 and 09:32:35.551829, Defendant did not sell any shares of PHUN in attributed Nasdaq orders, consistent with the fictitious nature of the Baiting Orders.

52. The Baiting Orders successfully induced the entry of sell orders from other market participants, driving the price of PHUN shares downward. At 09:30:35.551829, Defendant took advantage of this artificial downward pressure and executed Executing Purchases to buy a total of

---

<sup>10</sup> The volume of Baiting Orders is the lesser of the volume of attributed sell-side orders cancelled by the Defendant in the two minutes after the Executing Purchase and the volume of attributed sell-side orders created by the Defendant in the two minutes prior to the Executing Purchase (*i.e.*, the attributed sell-side orders cancelled by the Defendant within two minutes after the Executing Purchase whose aggregate volume was created by the Defendant within the two minutes prior to the Executing Purchase). The market impact of a Baiting Order is the same regardless of whether Defendant cancelled that specific Baiting Order or an equivalent order placed by Defendant on Nasdaq. For this reason, whenever prices for Baiting Orders are stated in this Complaint, those prices reflect the prices of orders cancelled after an Executing Purchase.

100 shares, at a price of \$1.63 per share, which was below the prevailing best offer of \$1.64 per share.

53. Defendant immediately began to cancel the artificial supply injected by these Baiting Orders within 365 microseconds of its Executing Purchases. By 09:32:35.551829, Defendant had cancelled the artificial supply injected by all of its Baiting Orders, eliminating the artificial sell-side imbalance that it falsely conveyed and injected into the market through its Baiting Orders.

54. Notably, in order to hide its spoofing activity, Defendant parked these Baiting Orders behind orders placed by other unsuspecting traders. For example, at 09:29:46.228947355, before Defendant had placed a single Baiting Order, Latour Trading LLC placed an order to sell 100 shares at \$1.71 per share, a better price than many of the Baiting Orders placed by Defendant. Latour Trading LLC did not cancel that order until 09:44:12.278734518, nearly 15 minutes later, consistent with market making activity and demonstrating the *bona fide* nature of its sell order. By contrast, Defendant rapidly cancelled all of its Baiting Orders after purchasing PHUN shares at an artificially depressed price.

55. Defendant sold PHUN shares both before and after this Executing Purchase, which enabled it to convert profits from its spoofing activity to cash regardless of whether the Executing Purchases established a long position in PHUN shares or were used to close out a previously established short position in PHUN shares. Specifically, Defendant sold 5,000 shares at a price of \$1.65 per share at 15:59:56 on April 28, 2021, after the Executing Purchase, which would have generated a return of 1.226994% on its Executing Purchases at the artificially depressed price of \$1.63 per share. Defendant also sold 40 shares at a price of \$1.90 per share at 09:34:43 on April 09, 2021, prior to the Executing Purchase, which would have generated a return of 16.56442% if

that sale created a short position that was closed out by the Executing Purchases at the artificially depressed price of \$1.63 per share.

**2. Example Episode: October 26, 2021 at 09:30:04.427209**

56. On October 26, 2021 at 09:30:04.427116000, the national best bid and offer for PHUN stock was a bid to purchase 13 shares at a price of \$6.25 per share and an offer to sell 176 shares at a price of \$6.26 per share.

57. From 09:28:04.427209 to 09:30:04.427209, Defendant placed 13,288 shares of Baiting Orders at prices ranging from \$300.00 to \$6.75 per share. As of 09:30:04.427209, the submission of these Baiting Orders left Defendant with an imbalanced order book position favoring the sell side among attributed Nasdaq orders. As calculated by Plaintiff, this order book position consisted of bids to purchase 4,333 shares at prices ranging from \$4.57 per share to \$6.25 per share, and an offer to sell 13,188 shares at prices ranging from \$6.40 per share to \$22.00 per share.

58. Between 09:30:04.427209 and 09:32:04.427209, Defendant sold only 1,241 shares of PHUN in attributed orders, consistent with the fictitious nature of the Baiting Orders.

59. The Baiting Orders successfully induced the entry of sell orders from other market participants, driving the price of PHUN shares downward. At 09:30:04.427209, Defendant took advantage of this artificial downward pressure and executed Executing Purchases to buy a total of 50 shares, at a price of \$6.25 per share, which was below the prevailing best offer of \$6.26 per share.

60. Defendant immediately began to cancel the artificial supply injected by these Baiting Orders within 3.592215 seconds. By 09:32:04.427209, Defendant had cancelled the artificial supply injected by all of its Baiting Orders, eliminating the artificial sell-side imbalance

it falsely conveyed and injected into the market through its Baiting Orders.

61. Defendant sold PHUN shares both before and after this Executing Purchase, which enabled it to convert profits from its spoofing activity to cash regardless of whether the Executing Purchases established a long position in PHUN shares or were used to close out a previously established short position in PHUN shares. Specifically, Defendant sold 20 shares at a price of \$6.40 per share at 09:30:21 on October 26, 2021, after the Executing Purchase, which would have generated a return of 2.40% on its Executing Purchases at the artificially depressed price of \$6.25 per share. Defendant also sold 500 shares at a price of \$7.15 per share at 16:00:00 on October 25, 2021, prior to the Executing Purchase, which would have generated a return of 14.40% if that sale created a short position that was closed out by the Executing Purchases at the artificially depressed price of \$6.25 per share.

### **3. Example Episode: October 27, 2021 at 09:30:36.323727**

62. On October 27, 2021 at 09:30:36.297767561, the national best bid and offer for PHUN stock was a bid to purchase 79 shares at a price of \$4.85 per share and an offer to sell 52 shares at a price of \$4.87 per share.

63. From 09:28:36.323727 to 09:30:36.323727, Defendant placed 19,820 shares of Baiting Orders at prices ranging from \$25.00 to \$5.09 per share. As of 09:30:36.323727, the submission of these Baiting Orders left Defendant with an imbalanced order book position favoring the sell side among attributed Nasdaq orders. As calculated by Plaintiff, this order book position consisted of bids to purchase 60,198 shares at prices ranging from \$3.63 per share to \$4.85 per share, and an offer to sell 173,158 shares at prices ranging from \$4.99 per share to \$100.00 per share.

64. Between 09:30:36.323727 and 09:32:36.323727, Defendant sold only 4,387 shares

of PHUN in attributed orders, consistent with the fictitious nature of the Baiting Orders.

65. The Baiting Orders successfully induced the entry of sell orders from other market participants, driving the price of PHUN shares downward. At 09:30:36.323727, Defendant took advantage of this artificial downward pressure and executed Executing Purchases to buy a total of 824 shares, at a price of \$4.85 per share, which was below the prevailing best offer of \$4.87 per share.

66. Defendant immediately began to cancel the artificial supply injected by these Baiting Orders within 24.61932 seconds. By 09:32:36.323727, Defendant had cancelled the artificial supply injected by all of its Baiting Orders, eliminating the artificial sell-side imbalance it falsely conveyed and injected into the market through its Baiting Orders.

67. Notably, in order to hide its spoofing activity, Defendant parked these Baiting Orders behind orders placed by other unsuspecting traders. For example, at 09:30:28.897143626, before Defendant had placed a single Baiting Order, Wall Street Access placed an order to sell 100 shares at \$6.01 per share, a better price than many of the Baiting Orders placed by Defendant. Wall Street Access did not cancel that order until 09:54:23.430989834, nearly 25 minutes later, consistent with market making activity and demonstrating the *bona fide* nature of the sell order. By contrast, Defendant rapidly cancelled all of its Baiting Orders after purchasing PHUN shares at an artificially depressed price.

68. Defendant sold PHUN shares both before and after this Executing Purchase, which enabled it to convert profits from its spoofing activity to cash regardless of whether the Executing Purchases established a long position in PHUN shares or were used to close out a previously established short position in PHUN shares. Specifically, Defendant sold 100 shares at a price of \$4.99 per share at 09:31:07 on October 27, 2021, after the Executing Purchase, which would have

generated a return of 2.886598% on its Executing Purchases at the artificially depressed price of \$4.85 per share. Defendant also sold 500 shares at a price of \$4.89 per share at 11:28:44 on October 26, 2021, prior to the Executing Purchase, which would have generated a return of 0.8247423% if that sale created a short position that was closed out by the Executing Purchases at the artificially depressed price of \$4.85 per share.

**4. Example Episode: October 28, 2021 at 09:31:29.737682**

69. On October 28, 2021 at 09:31:29.737640733, the national best bid and offer for PHUN stock was a bid to purchase 6 shares at a price of \$4.70 per share and an offer to sell 95 shares at a price of \$4.72 per share.

70. From 09:29:29.737682 to 09:31:29.737682, Defendant placed 1,320,303 shares of Baiting Orders at prices ranging from \$300.00 to \$4.95 per share. As of 09:31:29.737682, the submission of these Baiting Orders left Defendant with an imbalanced order book position favoring the sell side among attributed Nasdaq orders. As calculated by Plaintiff, this order book position consisted of bids to purchase 537,427 shares at prices ranging from \$0.02 per share to \$4.70 per share, and an offer to sell 1,320,303 shares at prices ranging from \$4.95 per share to \$300.00 per share.

71. Between 09:31:29.737682 and 09:33:29.737682, Defendant did not sell any shares of PHUN in attributed Nasdaq orders, consistent with the fictitious nature of the Baiting Orders.

72. The Baiting Orders successfully induced the entry of sell orders from other market participants, driving the price of PHUN shares downward. At 09:31:29.737682, Defendant took advantage of this artificial downward pressure and executed Executing Purchases to buy a total of 100 shares, at a price of \$4.70 per share, which was below the prevailing best offer of \$4.72 per share.

73. Defendant immediately began to cancel the artificial supply injected by these Baiting Orders within 399 microseconds of its Executing Purchases. By 09:33:29.737682, Defendant had cancelled the artificial supply injected by all of its Baiting Orders, eliminating the artificial sell-side imbalance that it falsely conveyed and injected into the market through its Baiting Orders.

74. Defendant sold PHUN shares both before and after this Executing Purchase, which enabled it to convert profits from its spoofing activity to cash regardless of whether the Executing Purchases established a long position in PHUN shares or were used to close out a previously established short position in PHUN shares. Specifically, Defendant sold 882 shares at a price of \$4.72 per share at 15:50:35 on October 28, 2021, after the Executing Purchase, which would have generated a return of 0.4255319% on its Executing Purchases at the artificially depressed price of \$4.70 per share. Defendant also sold 14 shares at a price of \$4.92 per share at 09:30:04 on October 28, 2021, prior to the Executing Purchase, which would have generated a return of 4.680851% if that sale created a short position that was closed out by the Executing Purchases at the artificially depressed price of \$4.70 per share.

#### **5. Example Episode: November 08, 2021 at 09:31:10.819250**

75. On November 08, 2021 at 09:31:10.819248177, the national best bid and offer for PHUN stock was a bid to purchase 39 shares at a price of \$4.10 per share and an offer to sell 8 shares at a price of \$4.11 per share.

76. From 09:29:10.819250 to 09:31:10.819250, Defendant placed 1,312,327 shares of Baiting Orders at prices ranging from \$500.00 to \$4.16 per share. As of 09:31:10.819250, the submission of these Baiting Orders left Defendant with an imbalanced order book position favoring the sell side among attributed Nasdaq orders. As calculated by Plaintiff, this order book

position consisted of bids to purchase 294,125 shares at prices ranging from \$0.02 per share to \$4.10 per share, and an offer to sell 1,312,327 shares at prices ranging from \$4.16 per share to \$500.00 per share.

77. Between 09:31:10.819250 and 09:33:10.819250, Defendant did not sell any shares of PHUN in attributed Nasdaq orders, consistent with the fictitious nature of the Baiting Orders.

78. The Baiting Orders successfully induced the entry of sell orders from other market participants, driving the price of PHUN shares downward. At 09:31:10.819250, Defendant took advantage of this artificial downward pressure and executed Executing Purchases to buy a total of 440 shares, at a price of \$4.10 per share, which was below the prevailing best offer of \$4.11 per share.

79. Defendant immediately began to cancel the artificial supply injected by these Baiting Orders within 167 microseconds of its Executing Purchases. By 09:33:10.819250, Defendant had cancelled the artificial supply injected by all of its Baiting Orders, eliminating the artificial sell-side imbalance that it falsely conveyed and injected into the market through its Baiting Orders.

80. Notably, in order to hide its spoofing activity, Defendant parked these Baiting Orders behind orders placed by other unsuspecting traders. For example, at 09:14:50.918999368, before Defendant had placed a single Baiting Order, Two Sigma Securities, LLC placed an order to sell 100 shares at \$5.28 per share, a better price than many of the Baiting Orders placed by Defendant. Two Sigma Securities, LLC did not cancel that order until the end of the trading day at 16:00:02.602535639, consistent with the *bona fide* nature of the sell order. By contrast, Defendant rapidly cancelled all of its Baiting Orders after purchasing PHUN shares at an artificially depressed price.



81. Defendant sold PHUN shares both before and after this Executing Purchase, which enabled it to convert profits from its spoofing activity to cash regardless of whether the Executing Purchases established a long position in PHUN shares or were used to close out a previously established short position in PHUN shares. Specifically, Defendant sold 5 shares at a price of \$4.30 per share at 15:54:50 on November 08, 2021, after the Executing Purchase, which would have generated a return of 4.878049% on its Executing Purchases at the artificially depressed price of \$4.10 per share. Defendant also sold 47 shares at a price of \$4.22 per share at 16:00:00 on November 05, 2021, prior to the Executing Purchase, which would have generated a return of 2.926829% if that sale created a short position that was closed out by the Executing Purchases at the artificially depressed price of \$4.10 per share.

**6. Example Episode: March 15, 2023 at 09:30:20.706990**

82. On March 15, 2023 at 09:30:10.742295128, the national best bid and offer for PHUN stock was a bid to purchase 6 shares at a price of \$0.77 per share and an offer to sell 33 shares at a price of \$0.771 per share.

83. From 09:28:20.706990 to 09:30:20.706990, Defendant placed 82,549 shares of Baiting Orders at prices ranging from \$288.00 to \$0.771 per share. As of 09:30:20.706990, the submission of these Baiting Orders left Defendant with an imbalanced order book position among attributed Nasdaq orders. As calculated by Plaintiff, this order book position consisted of bids to purchase 876 shares at prices ranging from \$0.532 per share to \$0.77 per share, and an offer to sell 82,549 shares at prices ranging from \$0.771 per share to \$2.50 per share.

84. Between 09:30:20.706990 and 09:32:20.706990, Defendant did not sell any shares of PHUN in attributed orders, consistent with the fictitious nature of the Baiting Orders.

85. The Baiting Orders successfully induced the entry of sell orders from other market

participants, driving the price of PHUN shares downward. At 09:30:20.706990, Defendant took advantage of this artificial downward pressure and executed Executing Purchases to buy a total of 167 shares, at a price of \$0.77 per share, which was below the prevailing best offer of \$0.771 per share.

86. Defendant immediately began to cancel the artificial supply injected by these Baiting Orders within 59.54329 seconds. By 09:32:20.706990, Defendant had cancelled the artificial supply injected by all of its Baiting Orders, eliminating the artificial sell-side imbalance it falsely conveyed and injected into the market through its Baiting Orders.

87. Notably, in order to hide its spoofing activity, Defendant parked these Baiting Orders behind orders placed by other unsuspecting traders. For example, at 09:30:01.385845217, before Defendant had placed a single Baiting Order, Flow Traders U.S. LLC placed an order to sell 100 shares at \$0.7942 per share, a better price than many of the Baiting Orders placed by Defendant. Flow Traders U.S. LLC did not cancel that order until over 15 minutes later at 09:47:37.301284608, consistent with the *bona fide* nature of the sell order. By contrast, Defendant rapidly cancelled all of its Baiting Orders after purchasing PHUN shares at an artificially depressed price.

88. Defendant sold PHUN shares both before and after this Executing Purchase, which enabled it to convert profits from its spoofing activity to cash regardless of whether the Executing Purchases established a long position in PHUN shares or were used to close out a previously established short position in PHUN shares. Specifically, Defendant sold 100 shares at a price of \$0.7799 per share at 15:55:00 on March 17, 2023, after the Executing Purchase, which would have generated a return of 1.285714% on its Executing Purchases at the artificially depressed price of \$0.77 per share. Defendant also sold 60 shares at a price of \$0.93 per share at 15:59:37 on March

06, 2023, prior to the Executing Purchase, which would have generated a return of 20.77922% if that sale created a short position that was closed out by the Executing Purchases at the artificially depressed price of \$0.77 per share.

**C. Defendant Intentionally Hid Its Manipulative Spoofing Scheme**

89. As described above, the manipulative process of spoofing requires that the true intent of the spoofer be hidden from the rest of the market. If other market participants knew that Baiting Orders were not *bona fide* orders but were instead entered solely to induce other traders to move the price of the stock, those other traders would naturally ignore the Baiting Orders when making trading decisions.

90. Defendant intentionally hid its manipulative spoofing scheme in order to achieve its illegal and improper goal of depressing the price of PHUN shares, and its success in manipulating that price demonstrates that its spoofing activity was concealed from the market.

**D. Defendant's Transactions In PHUN Are Not Legitimate Market Making Activity**

91. A market maker on Nasdaq is a broker-dealer that maintains firm bid and offer prices in a given stock by standing ready at all times to buy or sell round lots of that stock at publicly-quoted prices.<sup>11</sup> A Nasdaq market maker fulfills this obligation by entering quotations in the Nasdaq Market Center to buy and sell such security for its own account on a regular and continuous basis.<sup>12</sup>

92. Broker-dealers are registered as market makers on Nasdaq with respect to one or

---

<sup>11</sup> Nasdaq Website, available at <https://www.Nasdaq.com/glossary/m/market-maker> (last visited July 25, 2023).

<sup>12</sup> Listing Center, Nasdaq Website, available at <https://listingcenter.Nasdaq.com/rulebook/Nasdaq/rules/Nasdaq%205000%20Series/market%20maker/EQUALS/#position> (last visited July 25, 2023).

more particular securities, and under FINRA and SEC rules, are only considered to be “market makers” in the securities for which they are registered.<sup>13</sup>

93. Nasdaq rules require that a market maker “engage in a course of dealings for its own account to assist in the maintenance, insofar as reasonably practicable, of fair and orderly markets.”<sup>14</sup> In fulfilling this obligation, Nasdaq requires that a market maker “enter and maintain a two-sided trading interest that is identified to the Exchange as the interest meeting the obligation and is displayed in the Exchange’s quotation montage at all times.”<sup>15</sup>

94. These rules reflect the principle that a market maker ordinarily seeks to maintain a flat inventory position – or purchases and sales of stock in roughly comparable amounts – to provide liquidity to customers or other broker-dealers and to avoid placing a directional bet on the stock price. As Defendant itself wrote in a comment letter to the Securities and Exchange Commission:

If the Commission wishes to distinguish between legitimate market-making transactions and other transactions that are for proprietary, speculative purposes, one way may be to look at how the broker-dealer in fact behaves. A market-maker, as is well known, tends to stay “flat” whenever possible because it makes its money by profiting from spreads, not from taking a directionally biased position at market risk.<sup>16</sup>

---

<sup>13</sup> FINRA Website, available at <https://www.finra.org/rules-guidance/rulebooks/finra-rules/6320b> (last visited July 25, 2023).

<sup>14</sup> Nasdaq Rule 5, available at <https://listingcenter.nasdaq.com/rulebook/nasdaq/rules/Nasdaq%20Equity%202> (last visited July 25, 2023).

<sup>15</sup> *Id.* Moreover, “[a]fter an execution against its Two-Sided Obligation, a Nasdaq Market Maker must ensure that additional trading interest exists in the Exchange to satisfy its Two-Sided Obligation either by immediately entering new interest to comply with this obligation to maintain continuous two-sided quotations or by identifying existing interest on the Exchange book that will satisfy this obligation.”

<sup>16</sup> Comment Letter re: Proposed Regulation SHO; File No. S7-23-03 by J.P. Morgan Securities Inc. and UBS Securities LLC (Jan. 30, 2004), available at <https://www.sec.gov/rules/proposed/s72303/jpmorgan013004.htm>. (last visited July 25, 2023).

For this reason, following a purchase of stock, one would expect a market maker engaging in *bona fide* market making activities to price sell-side orders of the stock aggressively to flatten its inventory position. By contrast, an asymmetry in order cancellation rates involving the stock is inconsistent with *bona fide* market making activities.

95. This is, in fact, how Defendant itself behaved when serving as a market maker in highly liquid securities that are not amenable to the sort of manipulation observed in PHUN. For example, when executing purchases in the popular exchange-traded fund QQQ in December 2022, Defendant priced its sell-side orders, on median, 97.96% as aggressive as the most aggressively priced sell orders on the Nasdaq order book. This sort of aggressive pricing in order, in Defendant's own words, to "stay flat whenever possible," is exactly what one would expect of a market maker.

96. But that is not how Defendant behaved when trading in PHUN shares. Plaintiff has reviewed all of Defendant's deanonymized Nasdaq order flow and executions in PHUN shares during the Relevant Period. Under Nasdaq rules, orders placed pursuant to a market maker's obligation to maintain "fair and orderly markets" must be deanonymized and attributable to the market maker.

97. After spoofed Executing Purchases in PHUN shares, Defendant's most aggressive sell-side orders were, on median, 86.67% as aggressive as the most aggressively priced sell orders on the Nasdaq order book. That is, Defendant's sell-side orders after purchasing PHUN shares were **11% less** aggressive than when engaged in ordinary market making. That relative passivity in pricing sell-side orders after spoofed Executing Purchases is consistent with Defendant using sell-side orders to maintain downward pressure on the share price rather than seeking to aggressively flatten their inventory as in *bona fide* market making.

98. Further evidence that Defendant was not acting as a *bona fide* market maker in

connection with its unlawful spoofing activity is demonstrated by comparing the aggressiveness of its sell side order pricing following non-spoofed purchases. Following these purchases, Defendant priced its sell-side orders, on median, 99.08% as aggressive as the most aggressively priced sell orders on the Nasdaq order book. Thus, Defendant's behavior when spoofing the shares of PHUN was fundamentally different from how it behaved when engaging in *bona fide* market making.

**E. Defendant Acted With Scienter**

99. Based on the alleged facts herein, Defendant acted with scienter. Defendant knowingly or with severe recklessness engaged in unlawful conduct intended to—and in fact did—deceive, manipulate, or defraud the market for PHUN shares and participants in that market, including Plaintiff.

100. ***First***, that Defendant specifically designed and implemented algorithmic trading programs to execute its spoofing schemes is indicative of its scienter. Its algorithms were programmed to, and did, generate trading patterns that involved the placement and cancellation of tens of millions of Baiting Orders to sell in the Limit Order Book that were never intended to be executed during the Relevant Period. Moreover, Defendant—which is a sophisticated entity utilizing cutting edge technology—closely monitored, modeled, and analyzed the performance, impact, and effects of its algorithmic trading programs throughout the Relevant Period, including the spoofing pattern which the algorithm executed again and again on PHUN stock during the Relevant Period with similar effects each time.

101. ***Second***, that Defendant's trading activities were approved by corporate officials sufficiently knowledgeable about the trading practices of Defendant such that Defendant knew that it was engaging in illegal spoofing is indicative of its scienter.

102. **Third**, that as a registered broker-dealer, Defendant knew and/or was required to know that it was unlawful to place Baiting Orders to sell in a Limit Order Book that were never intended to be executed in order to trick market participants into selling shares of PHUN stock is indicative of its scienter. Indeed, UBS's website states that "[w]hen using or interacting with UBS as broker-dealer with respect to a transaction, clients must not" engage in activities prohibited by securities, which expressly include "non-bona fide activities to induce others to trade, ... spoofing, [and] layering."<sup>17</sup>

103. **Fourth**, that Defendant was obligated to and certified in its FINRA Report 3130s that it, in fact did, monitor, detect, and prevent manipulative or fraudulent trading is indicative of its scienter. As a registered broker-dealer, Defendant was required, pursuant to FINRA Rule 2020, to have internal policies, procedures and systems that detected and prohibited manipulative or fraudulent trading devices or schemes, and pursuant to FINRA Rules 5210, Supplementary Material .02; Rule 1220 and Exchange Rule 575, Disruptive Practices Prohibited, to detect and prevent manipulative or fraudulent trading that originated from algorithmic high-speed trading under the supervision and control of its firm. Indeed, during the Relevant Period, Defendant filed an "Annual Certification of Compliance and Supervisory Processes," pursuant to FINRA Report 3130, in which it confirmed that it:

(A) establish[ed], maintain[ed] and review[ed] policies and procedures reasonably designed to achieve compliance with applicable FINRA rules, Municipal Securities Rulemaking Board ("MSRB") rules and federal securities laws and regulations; (B) modif[ied] such policies and procedures as business, regulatory and legislative changes and events dictate; and (C) test[ed] the effectiveness of such policies and procedures on a periodic basis, the timing and extent of which is reasonably designed to ensure continuing compliance with FINRA rules, MSRB rules and federal securities laws and regulations.

---

<sup>17</sup> UBS website, available at <https://www.ubs.com/global/en/investment-bank/us-broker-dealer/order-handling-retail.html> (last visited July 25, 2023).

104. **Fifth**, that Defendant was less likely to aggressively price sell orders after spoofed Executing Purchases as compared to non-spoofed purchases is inconsistent with *bona fide* market making and is indicative of Defendant's scienter. This is particularly true given that Defendant acted aggressively in pricing sell orders in other securities during the same time period, demonstrating that it knew how to engage in true market making, despite not doing so in PHUN.

105. **Sixth**, that Defendant "parked" its Baiting Orders behind *bona fide* sell orders by other market participants demonstrates that Defendant was not engaging in legitimate market activity and is indicative of Defendant's scienter. Parking involves placing Baiting Orders to sell behind *bona fide* sell orders placed by other unsuspecting traders. These *bona fide* orders serve as a barrier between ordinary demand for the security and the Baiting Orders, making it less likely that the Baiting Orders will execute in orders to purchase the security placed by other market participants. By parking the Baiting Orders, Defendant ensured that those Baiting Orders were extraordinarily unlikely to be executed, and thus shows that Defendant never intended for its Baiting Orders to be executed.

106. **Seventh**, that Defendant's Baiting Orders frequently left Defendant with an imbalanced order book position favoring the sell side is indicative of Defendant's scienter. Despite these imbalanced order book positions, Defendant often did not sell **any** shares of PHUN after posting the Baiting Orders. This is consistent with the fictitious nature of the Baiting Orders and indicates that Defendant never intended to execute any of its numerous Baiting Orders; instead, Defendant placed the Baiting Orders in order to create artificial selling pressure and induce other market participants to submit additional sell orders, and thus artificially drive down the price of PHUN shares. This behavior is contrary to the behavior of an ordinary trader who buys when it thinks the price of a security is likely to go higher and sells when it thinks the price of a security



will go lower, and thus rarely, if ever, develops such an imbalance that never get executed.

107. ***Eighth***, that there was a short time period between the placement and cancellation of its Baiting Orders is indicative of Defendant's scienter. Following each spoofed Executing Purchase, Defendant placed and then cancelled the Baiting Orders within seconds, and at times microseconds and milliseconds. This practice, which occurred over one thousand times during the Relevant Period, indicates that Defendant never intended to execute the Baiting Orders.

108. ***Ninth***, the concentration of cancelled Baiting Orders during the limited period when each spoofing event occurred is indicative of Defendant's scienter. Following each spoofed Executing Purchase, Defendant cancelled all of the Baiting Orders, sometimes amounting to millions of sell-side shares in a matter of seconds and sometimes milliseconds, all of which had been placed by Defendant at most mere minutes earlier.

109. ***Tenth***, the size of the Baiting Orders that were cancelled, in comparison to the size of bona-fide sell-side orders that were executed by Defendant is indicative of Defendant's scienter. Prior to each spoofed Executing Purchase, Defendant placed and subsequently cancelled a median of 9,862 shares in Baiting Orders while according to available data executed a median of 3 shares in sell-side orders. The stark contrast between the share volume of Baiting Orders and executed sell-side orders is additional and further indication that Defendant was manipulating the market by using Baiting Orders as tools to generate artificial prices, rather than making a genuine attempt to sell PHUN shares.

110. ***Eleventh***, the ratio of Defendant's cancelled Baiting Orders compared to Defendant's executed *bona fide* orders to sell is indicative of Defendant's scienter. Prior to each spoofed Executing Purchase, Defendant placed and subsequently cancelled a median of 9,862 sell-side shares in Baiting Orders while, according to data available to Plaintiff, executed a median of

3 shares in sell-side orders. An extremely high sell-side cancellation rate, such as the 99.97% here, is a strong indication that Defendant never intended to execute those Baiting Orders.

111. **Twelfth**, the size of Defendant's executed sell-side orders compared to the size of Defendant's Executing Purchases is indicative of Defendant's scienter. On median, Defendant executed 100 shares in each Executing Purchase, while in contrast Defendant executed 3 shares in sell-side orders in attributed Nasdaq orders in the minute following those purchases. The stark contrast between the share volume of Defendant's Executing Purchases and Defendant's sell-side executions is additional and further indication that Defendant was manipulating the market by using Baiting Orders as tools to generate artificial prices at which to execute spoofed purchases at favorable prices.

112. **Thirteenth**, the ratio of Defendant's executed sell-side orders compared to Defendant's Executing Purchases is indicative of Defendant's scienter. On median, Defendant executed 100 shares in each Executing Purchase, while in contrast Defendant executed 3 shares in sell-side orders in attributed Nasdaq orders in the minute following those purchases. A lopsided ratio, such as 100-to-3 as here, is additional and further indication that Defendant never intended to execute its Baiting Orders to sell.

113. **Fourteenth**, that Defendant placed tens of millions of Baiting Orders and purchased hundreds of thousands of PHUN shares at spoofed prices during the Relevant Period, and often multiple episodes per trading day, is indicative of Defendant's scienter. The repetition of this pattern of placing fictitious Baiting Orders which created artificial prices, Executing Purchases at the artificial prices, and then cancelling all of the Baiting Orders, is indicative of Defendant's scienter.

114. **Fifteenth**, that Defendant's behavior resulted in asymmetric order cancellation

rates is inconsistent with *bona fide* market-making and is indicative of Defendant's scienter. Over Cancellation Periods, on average, Defendant cancelled 81% of the sell-side orders created during Baiting Periods, but only 64% of the buy-side orders created during Baiting Periods.

115. ***Sixteenth***, that there is an extremely low statistical likelihood that the price variations for each of the Spoofing Episodes occurred naturally is indicative of Defendant's scienter. The market impact of these Spoofing Episodes was material and statistically significant.

116. ***Finally***, that Defendant had a strong motive to spoof the shares of PHUN stock and engage in its manipulative scheme is indicative of Defendant's scienter. By manipulating down the share price of PHUN, Defendant was able to make at least hundreds of millions in aggregate profits by purchasing tens of millions of shares of PHUN at artificially depressed prices.

#### **F. Loss Causation And Standing**

117. Plaintiff sold over 40 million shares of PHUN stock in hundreds of distinct transactions at share prices artificially depressed by Defendant's manipulative spoofing during and following the Relevant Period, including as late as April 27, 2023. *See* Exhibit 2.<sup>18</sup>

118. Millions of those sales occurred just seconds or hours after Defendant's unlawful spoofing activity caused Phunware's share price to artificially decline, causing Plaintiff to suffer losses. A list of Plaintiff's intraday executions is given in the chart below.<sup>19</sup>

---

<sup>18</sup> Plaintiff anticipates that discovery will reveal that Defendant engaged in additional spoofing activity during times when Plaintiff sold millions of additional shares of stock at prices artificially depressed by such spoofing activity. Indeed, Plaintiff has learned that Defendant engaged in spoofing of Phunware stock on July 10 and 13, 2023, within four minutes and within fifty seconds, respectively, of Plaintiff's sales on those dates of thousands of shares of stock at artificially depressed prices.

<sup>19</sup> The following chart of order executions reflects the exact time at which specific sales of PHUN stock were executed. They are thus subsumed within the blocks of sales of shares listed in Exhibit 2.

<b>Date</b>	<b>Time of First Sell-Side Baiting Order</b>	<b>Time of Executing Purchase</b>	<b>Executing Time of Sale by Plaintiff</b>	<b>Difference in Time from First Sell-Side Baiting Order</b>
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:01.265	00:00:00.148
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:04.381	00:00:03.264
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:04.392	00:00:03.275
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:04.400	00:00:03.283
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:04.880	00:00:03.763
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:04.890	00:00:03.773
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:04.900	00:00:03.783
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:06.617	00:00:05.500
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:06.627	00:00:05.510
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:06.633	00:00:05.516
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:06.640	00:00:05.523
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:06.645	00:00:05.528
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:06.650	00:00:05.533
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:06.657	00:00:05.540
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:10.166	00:00:09.049
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:10.175	00:00:09.058
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:10.180	00:00:09.063
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:10.262	00:00:09.145
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:10.268	00:00:09.151
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:10.274	00:00:09.157
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:10.280	00:00:09.163
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:10.285	00:00:09.168
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:10.290	00:00:09.173
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:12.406	00:00:11.289
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:12.415	00:00:11.298
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:23.461	00:00:22.344
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:23.471	00:00:22.354
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:23.481	00:00:22.364
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:23.676	00:00:22.559
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:23.682	00:00:22.565
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:23.688	00:00:22.571
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:23.694	00:00:22.577
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:23.701	00:00:22.584
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:23.706	00:00:22.589
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:23.713	00:00:22.596

<b>Date</b>	<b>Time of First Sell-Side Baiting Order</b>	<b>Time of Executing Purchase</b>	<b>Executing Time of Sale by Plaintiff</b>	<b>Difference in Time from First Sell-Side Baiting Order</b>
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:23.718	00:00:22.601
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:23.723	00:00:22.606
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:23.728	00:00:22.611
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:23.733	00:00:22.616
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:23.739	00:00:22.622
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:23.744	00:00:22.627
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:23.749	00:00:22.632
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:23.754	00:00:22.637
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:23.760	00:00:22.643
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:23.766	00:00:22.649
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:23.771	00:00:22.654
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:23.776	00:00:22.659
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:23.781	00:00:22.664
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:23.786	00:00:22.669
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:23.791	00:00:22.674
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:23.797	00:00:22.680
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:25.467	00:00:24.350
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:25.476	00:00:24.359
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:25.486	00:00:24.369
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:37.059	00:00:35.942
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:37.163	00:00:36.046
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:37.173	00:00:36.056
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:37.182	00:00:36.065
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:37.217	00:00:36.100
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:37.226	00:00:36.109
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:37.236	00:00:36.119
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:37.248	00:00:36.131
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:37.266	00:00:36.149
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:37.271	00:00:36.154
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:41.146	00:00:40.029
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:41.281	00:00:40.164
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:41.298	00:00:40.181
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:43.619	00:00:42.502
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:47.860	00:00:46.743
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:47.880	00:00:46.763

<b>Date</b>	<b>Time of First Sell-Side Baiting Order</b>	<b>Time of Executing Purchase</b>	<b>Executing Time of Sale by Plaintiff</b>	<b>Difference in Time from First Sell-Side Baiting Order</b>
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:50.438	00:00:49.321
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:50.447	00:00:49.330
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:51.297	00:00:50.180
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:51.303	00:00:50.186
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:51.308	00:00:50.191
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:51.314	00:00:50.197
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:51.319	00:00:50.202
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:51.324	00:00:50.207
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:51.329	00:00:50.212
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:58.822	00:00:57.705
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:58.829	00:00:57.712
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:58.835	00:00:57.718
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:58.840	00:00:57.723
01/26/21	09:30:01.117182118	09:30:02.620695849	09:30:58.846	00:00:57.729
01/26/21	09:30:01.117182118	09:30:02.620695849	09:31:04.174	00:01:03.057
01/26/21	09:30:01.117182118	09:30:02.620695849	09:31:06.389	00:01:05.272
01/26/21	09:30:01.117182118	09:30:02.620695849	09:31:06.396	00:01:05.279
01/26/21	09:30:01.117182118	09:30:02.620695849	09:31:06.402	00:01:05.285
01/26/21	09:30:01.117182118	09:30:02.620695849	09:31:06.407	00:01:05.290
01/26/21	09:30:01.117182118	09:30:02.620695849	09:31:06.412	00:01:05.295
01/26/21	09:30:01.117182118	09:30:02.620695849	09:31:06.419	00:01:05.302
01/26/21	09:30:01.117182118	09:30:02.620695849	09:31:06.427	00:01:05.310
01/26/21	09:30:01.117182118	09:30:02.620695849	09:31:06.435	00:01:05.318
01/26/21	09:30:01.117182118	09:30:02.620695849	09:31:06.440	00:01:05.323
01/26/21	09:30:01.117182118	09:30:02.620695849	09:31:06.448	00:01:05.331
01/26/21	09:30:01.117182118	09:30:02.620695849	09:31:06.454	00:01:05.337
01/26/21	09:30:01.117182118	09:30:02.620695849	09:31:06.461	00:01:05.344
01/26/21	09:30:01.117182118	09:30:02.620695849	09:31:06.468	00:01:05.351
01/26/21	09:30:01.117182118	09:30:02.620695849	09:31:06.473	00:01:05.356
01/26/21	09:30:01.117182118	09:30:02.620695849	09:31:06.479	00:01:05.362
01/26/21	09:30:01.117182118	09:30:02.620695849	09:31:06.484	00:01:05.367
01/26/21	09:30:01.117182118	09:30:02.620695849	09:31:06.490	00:01:05.373
01/26/21	09:30:01.117182118	09:30:02.620695849	09:31:06.496	00:01:05.379
01/26/21	09:30:01.117182118	09:30:02.620695849	09:31:06.504	00:01:05.387
01/26/21	09:30:01.117182118	09:30:02.620695849	09:31:06.510	00:01:05.393

<b>Date</b>	<b>Time of First Sell-Side Baiting Order</b>	<b>Time of Executing Purchase</b>	<b>Executing Time of Sale by Plaintiff</b>	<b>Difference in Time from First Sell-Side Baiting Order</b>
01/26/21	09:30:01.117182118	09:30:02.620695849	09:31:06.515	00:01:05.398
01/26/21	09:30:01.117182118	09:30:02.620695849	09:31:06.521	00:01:05.404
01/26/21	09:30:01.117182118	09:30:02.620695849	09:31:06.526	00:01:05.409
01/26/21	09:30:01.117182118	09:30:02.620695849	09:31:06.534	00:01:05.417
01/26/21	09:30:01.117182118	09:30:02.620695849	09:31:06.541	00:01:05.424
01/26/21	09:30:01.117182118	09:30:02.620695849	09:31:08.544	00:01:07.427
01/26/21	09:30:01.117182118	09:30:02.620695849	09:31:08.555	00:01:07.438
01/26/21	09:30:01.117182118	09:30:02.620695849	09:31:13.854	00:01:12.737
01/26/21	09:30:01.117182118	09:30:02.620695849	09:31:15.088	00:01:13.971
01/26/21	09:30:01.117182118	09:30:02.620695849	09:31:15.462	00:01:14.345
01/26/21	09:30:01.117182118	09:30:02.620695849	09:31:15.472	00:01:14.355
01/26/21	09:30:01.117182118	09:30:02.620695849	09:31:15.482	00:01:14.365
10/21/21	15:53:52.123116845	15:55:46.648149	17:43:48.891144	01:49:56.768
10/21/21	15:54:37.251990255	15:56:26.753123	17:43:48.891144	01:49:11.639
10/21/21	15:55:07.424418204	15:56:58.387656	17:43:48.891144	01:48:41.467
10/26/21	09:30:00.228186415	09:30:01.123261	09:33:24.670265	00:03:24.442
10/26/21	09:30:00.228186415	09:30:01.133721	09:33:24.670265	00:03:24.442
10/26/21	09:30:00.228186415	09:30:01.133737	09:33:24.670265	00:03:24.442
10/26/21	09:30:00.228186415	09:30:01.134776	09:33:24.670265	00:03:24.442
10/26/21	09:30:00.228186415	09:30:01.152920	09:33:24.670265	00:03:24.442
10/26/21	09:30:00.228186415	09:30:01.152942	09:33:24.670265	00:03:24.442
10/26/21	09:30:00.228186415	09:30:01.154146	09:33:24.670265	00:03:24.442
10/26/21	09:30:00.228186415	09:30:01.154164	09:33:24.670265	00:03:24.442
10/26/21	09:30:00.228186415	09:30:01.179301	09:33:24.670265	00:03:24.442
10/26/21	09:30:00.228186415	09:30:01.183063	09:33:24.670265	00:03:24.442
10/26/21	09:30:00.228186415	09:30:01.191782	09:33:24.670265	00:03:24.442
10/26/21	09:30:00.228186415	09:30:01.201872	09:33:24.670265	00:03:24.442
10/26/21	09:30:00.228186415	09:30:01.204190	09:33:24.670265	00:03:24.442
10/26/21	09:30:00.228186415	09:30:01.212080	09:33:24.670265	00:03:24.442
10/26/21	09:30:00.228186415	09:30:01.216473	09:33:24.670265	00:03:24.442
10/26/21	09:30:00.228186415	09:30:01.216490	09:33:24.670265	00:03:24.442
10/26/21	09:30:00.228186415	09:30:01.216517	09:33:24.670265	00:03:24.442
10/26/21	09:30:00.228186415	09:30:01.327084	09:33:24.670265	00:03:24.442
10/26/21	09:30:00.228186415	09:30:01.341409	09:33:24.670265	00:03:24.442
10/26/21	09:30:00.228186415	09:30:01.350919	09:33:24.670265	00:03:24.442



<b>Date</b>	<b>Time of First Sell-Side Baiting Order</b>	<b>Time of Executing Purchase</b>	<b>Executing Time of Sale by Plaintiff</b>	<b>Difference in Time from First Sell-Side Baiting Order</b>
<b>10/26/21</b>	09:30:00.228186415	09:30:01.351191	09:33:24.670265	00:03:24.442
<b>10/26/21</b>	09:30:00.228186415	09:30:01.354481	09:33:24.670265	00:03:24.442
<b>10/26/21</b>	09:30:00.228186415	09:30:01.356463	09:33:24.670265	00:03:24.442
<b>10/26/21</b>	09:30:00.228186415	09:30:04.386483	09:33:24.670265	00:03:24.442
<b>10/26/21</b>	09:30:00.228186415	09:30:04.418685	09:33:24.670265	00:03:24.442
<b>10/26/21</b>	09:30:00.228186415	09:30:04.427208	09:33:24.670265	00:03:24.442
<b>10/26/21</b>	09:30:00.228186415	09:30:08.012528	09:33:24.670265	00:03:24.442
<b>10/26/21</b>	09:30:00.228186415	09:30:08.013923	09:33:24.670265	00:03:24.442
<b>10/26/21</b>	09:30:00.228186415	09:30:08.014400	09:33:24.670265	00:03:24.442
<b>10/26/21</b>	09:30:00.228186415	09:30:08.014758	09:33:24.670265	00:03:24.442
<b>10/26/21</b>	09:30:00.228186415	09:30:10.318990	09:33:24.670265	00:03:24.442
<b>10/26/21</b>	09:30:00.228186415	09:30:10.348146	09:33:24.670265	00:03:24.442
<b>10/27/21</b>	09:30:01.532417730	09:30:36.323726	09:35:07.874912	00:05:06.343
<b>10/27/21</b>	09:30:01.532417730	09:30:36.358186	09:35:07.874912	00:05:06.343

119. In addition, on February 12, 2021, Plaintiff sold 11.7 million shares at a price negatively impacted by Defendant's spoofs less than 10 trading minutes prior.

120. Defendant's manipulative spoofing had both an immediate and a long-term adverse effect on the market price of PHUN stock.

121. As detailed below, Defendant's spoofing caused an immediate and sustained decline in the price of PHUN shares that harmed Plaintiff when it sold its shares in temporal proximity to Defendant's spoofing. The impact of Defendant's spoofing activity extended beyond the specific spoofing cycle (*i.e.*, orders, trades, and cancellations) because the market neither immediately nor fully rebounded from the manipulated prices once each of the Spoofing Episodes was completed.

122. The negative price impact of Defendant's spoofing activity – over 1,000 Spoofing Episodes on 91 trading days during the Relevant Period – did not dissipate immediately following the Baiting Orders, however. Rather, as the quantitative analysis herein demonstrates, the



cumulative effect of Defendant's sustained spoofing placed enormous downward pressure on the market price of PHUN shares, which persisted for at least 60 days. This is confirmed by the economic literature which establishes that the artificially depressed price caused by spoofing generally does not fully recover to the price that existed prior to the spoofing when spoofing events occur continuously throughout the day and continue without interruption over a protracted period of time.<sup>20</sup>

123. Accordingly, the prices at which Plaintiff sold all of its stock throughout the entire Relevant Period (Exhibit 2) were negatively affected by Defendant's spoofing that occurred prior to Plaintiff's sales, regardless of how much time elapsed from a spoof to sale.

124. The following figure shows the average price impact of Spoofing Episodes over the minutes following each Spoofing Episode. The figure also shows the average price changes in the Nasdaq Composite Index (NASX) and in the Nasdaq-100 Technology Index (NDXT),<sup>21</sup> demonstrating that the negative average price impact on PHUN was the result of Defendant's spoofing rather than of market-wide conditions.<sup>22</sup> (95% confidence intervals are illustrated by the

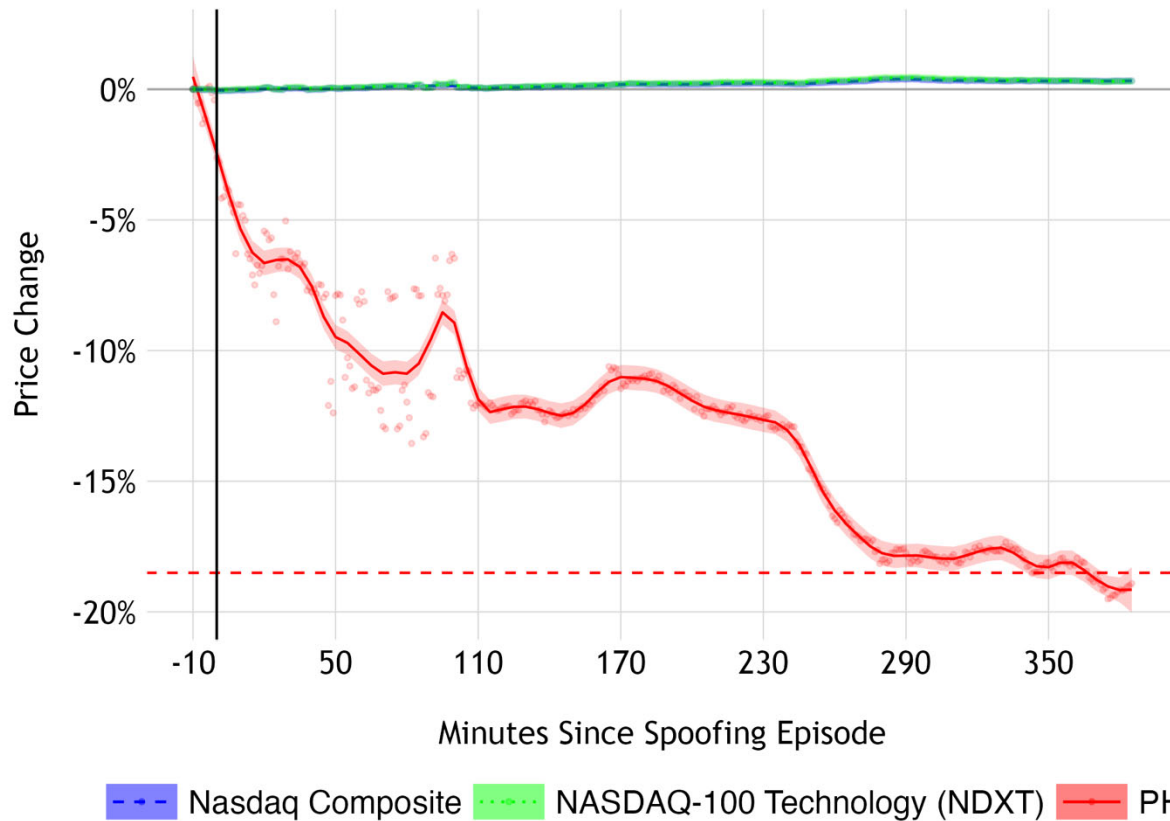
---

<sup>20</sup> Whether the prevailing market sentiment towards PHUN at any particular moment was trending in a positive or negative direction does not alter the fact that the Defendant's spoofing caused a negative impact on the price of PHUN shares, depressing the price from what it would have been in an unmanipulated market. Whether the market was reacting at any particular instant to positive or negative news regarding PHUN, the market price of its stock was lower than it would have been throughout the Relevant Period absent Defendant's manipulative conduct.

<sup>21</sup> NASX and NDXT are standard and appropriate benchmarks for PHUN. A regression of PHUN's daily returns (percentage price changes) on the daily returns of NASX and on the daily returns of NDXT yields positive and statistically significant coefficients of 1.07 ( $p = 0.0528$ ) and 0.912 ( $p = 0.0284$ ), respectively.

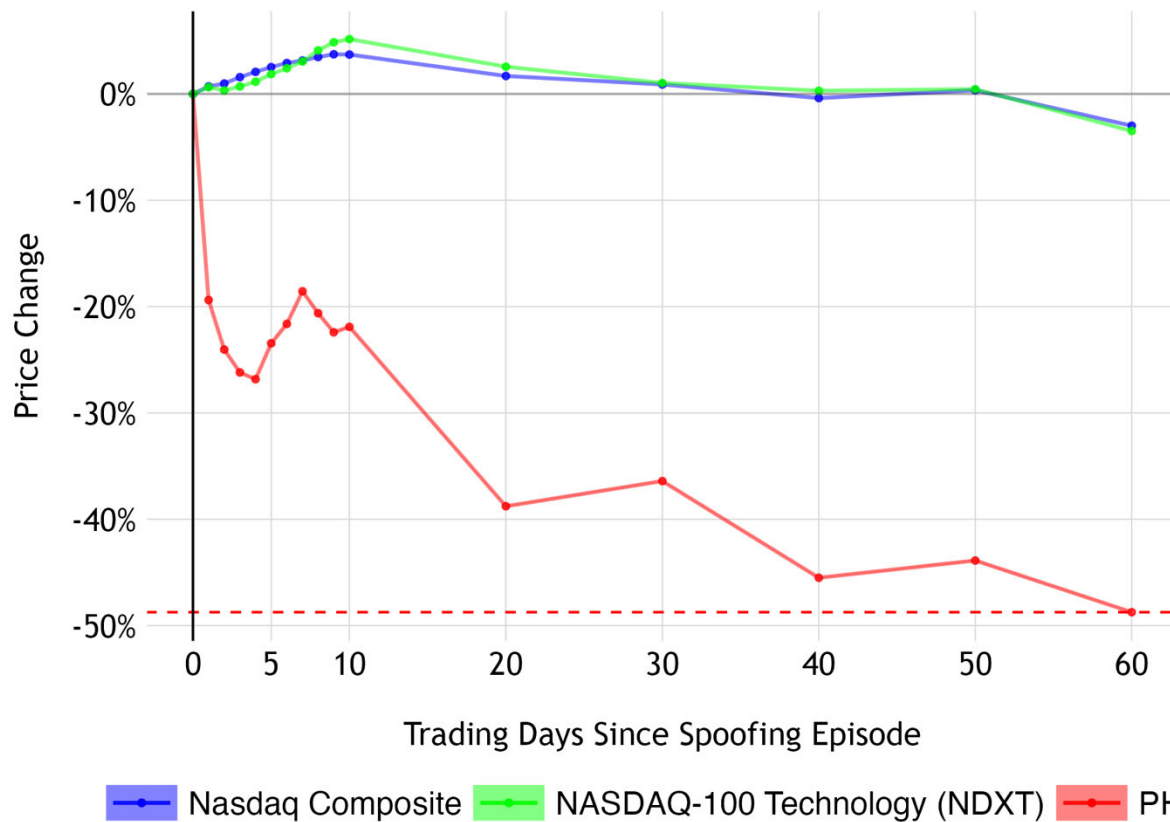
<sup>22</sup> Because the Spoofing Episodes occurred at short, discrete intervals in time, news about PHUN or other firm-specific events cannot explain these price declines. For the price decline following Spoofing Episodes to be driven by these events, the event would need to occur at exactly the same time as the Spoofing Episodes. But these events are not occurring at the same time as Spoofing Episodes. Thus, the price impact of those events is incorporated into the price of PHUN shares at a different point in time—either long before the Spoofing Episodes or long after, but not at the exact moment of those Spoofing Episodes.

shaded regions around the solid lines.)



125. As the above figure shows, the periods after Spoofing Episodes were characterized by a price decline followed by a *partial* reversion that provided Defendant an opportunity to profit from its purchases (including Executing Purchases) at depressed prices. Following the *partial* reversion, PHUN's share price stabilized, but at a *still depressed* level.

126. The sustained, repetitive, and continuous stream of Defendant's spoofing had a persistent long-term negative impact on the price of PHUN shares. The following figure shows the average change in Phunware's share price from the 2 minutes prior to Spoofing Episodes to the trading days thereafter, as well as the average changes in the NASX and NDXT over the same periods:



127. As the above figure shows, the negative price impact of Spoofing Episodes persisted at least sixty (60) trading days following the Spoofing Episodes, during times when both NASX and NDXT were increasing in value or remaining flat. After twenty (20) days, PHUN's price decline began to stabilize, but persisted at a depressed price for at least an additional forty (40) days and did not revert to its pre-Spoofing Episode price in the following trading days. The gradual stabilization of the decline in the price of PHUN shares from between twenty (20) to sixty (60) trading days after the Spoofing Episodes makes clear that the decline was not driven by negative news affecting the price of PHUN shares during the Relevant Period, because such news would have continued to cause a further price decline on the dates following Spoofing Episodes.

128. As Nobel prize winning economist Professor Paul Milgrom explains, this price decline persists "[b]ecause manipulative trades are viewed by market participants as potentially

informed, and potentially informed trades can result in permanent price impact, [therefore] manipulative trades can lead to permanent price impact.” *See supra* ¶ 35 (the Milgrom Report is attached as Exhibit 3).<sup>23</sup>

129. The Milgrom Report discusses the extensive economic literature establishing that the price impact of *any* form of trade-based manipulation, including spoofing, typically does not fully reverse. This conclusion applies to spoofing for two reasons. First, peer-reviewed research has found that sell-side order cancellations drive the price *up* by *less* than new sell-side orders drive the price *down*.<sup>24</sup> For this reason, the impact of Baiting Orders is not likely to dissipate merely because those orders were subsequently cancelled. Second, manipulative spoofing causes the execution of “*trades*,” not only the placement of orders, because Baiting Orders induce other market participants to sell shares at artificially depressed transaction prices.

130. The economic literature recognizes that in modern securities markets, every transaction occurs between a *liquidity maker* and a *liquidity taker*.<sup>25</sup> The term “liquidity maker” refers to the party who places an order to buy or sell shares that is *non-marketable*. A “non-marketable” order has a price that is too low (for a purchase) or too high (for a sale), relative to the current willingness of other market participants to transact. For example, suppose the last trading price of a security was \$9.99 and the best bid—*i.e.*, the highest price that buyers are willing

---

<sup>23</sup> *See* Basil Williams & Andrzej Skrzypacz, *Spoofing in Equilibrium*, at 3 (Feb. 2021), [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=3742327](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3742327) (disagreeing that spoofing is “an out-of-equilibrium phenomenon that can be completely neutralized by sophisticated traders once understood by all market participants”).

<sup>24</sup> Jonathan Brogaard, Terrence Hendershott & Ryan Riordan, *Price Discovery without Trading: Evidence from Limit Orders* 74 J. FIN. 1583, 1635 (2019) (magnitude of price impact of order placement exceeds magnitude of price impact of order cancel).

<sup>25</sup> Yong Chao, Chen Yao & Mao Ye, *Discrete Pricing and Market Fragmentation: A Tale of Two-Sided Markets*, 105 AM. ECON. REV. PAP. & PROC. 196 (2017) (“A trader can act as a liquidity maker by posting a limit order with a specified price and quantity. A trade occurs when a liquidity taker accepts the terms of a limit order.”).

to pay—is \$9.98 and the best offer—*i.e.*, the lowest price that sellers are willing to accept—is \$10.00 per share. If a market participant places a buy order at a price of \$9.99 (or less) per share, that order will be ***non-marketable*** because there is no seller who is willing to sell at \$9.99 per share at that point in time. That buy order will, however, remain in the Limit Order Book, ready to transact with a seller who is willing to sell shares at a price of \$9.99 (or less) per share.

131. By contrast, the term “liquidity taker” refers to the party who places an order to buy or sell shares that is ***marketable***. A “marketable” order has a price that is high enough (for a purchase) or low enough (for a sale), relative to the current willingness of other market participants to transact. Returning to the prior example, a buy order at a price of \$10.00 (or more) per share would be a marketable order because a market participant had previously submitted an existing sell order at a price of \$10.00 per share. Every transaction in the market occurs between a marketable and a non-marketable order, but prices generally move in the direction of marketable orders. In the preceding example, a marketable buy order at \$10.00 per share would execute against a non-marketable sell order at \$10.00 per share, causing the price to increase from \$9.99 to \$10.00 per share.<sup>26</sup>

132. ***Every Executing Purchase*** alleged in this Complaint consists of a non-marketable buy order executing against a marketable sell order by another market participant, leading to a

---

<sup>26</sup> In general, non-marketable buy and sell orders typically are placed on either side of the last transaction price. Thus, if the last transaction price was \$9.99 (as in this example), a non-marketable buy order typically would be placed at \$9.98 (or less) and a non-marketable sell order typically would be placed at \$10.00 (or more). *See, e.g.*, Lawrence R. Glosten & Paul R. Milgrom, *Bid, Ask and Transaction Prices in a Specialist Market with Heterogeneously Informed Traders*, 14 J. FIN. ECON. 71 (1985) (deriving bid/ask spread). Transaction prices generally move in the direction of marketable orders because marketable buy (or sell) orders execute against non-marketable sell (or buy) orders which are above (or below) the previous transaction price.

decline in PHUN's share price.<sup>27</sup> For this reason, Executing Purchases reflect the execution of aggressively priced sell orders which were induced by the Baiting Orders. Accordingly, the spoofing activity consists of *trade-based manipulation* whereby Baiting Orders induced market participants to place marketable sell orders that executed against Defendant's non-marketable Executing Purchases. *Supra* ¶¶ 52, 59, 65, 72, 78, 85.

133. The placement of non-marketable buy orders after the completion of a Spoofing Episode induced only a ***partial price reversion*** that did not fully unwind the impact of Defendant's manipulative spoofing. Therefore, prices of PHUN stock did not fully revert to the market level, even though these partial price reversions provided Defendant an opportunity to profit from buying additional PHUN shares.

134. Because the price of PHUN shares may have been higher or lower after any single Spoofing Episode for reasons that would have occurred absent Defendant's spoofing—such as increasing investor enthusiasm—the price impact of Defendant's spoofing activity is not measured by what happened to the stock price in a given instance, but by the average price impact over those episodes, as shown *supra* ¶ 124. Otherwise, the determination of whether spoofing affected the price would be confounded by factors, like changes in investor enthusiasm, that would have occurred even if no spoofing had occurred at all.

135. Moreover, the Milgrom Report explains that manipulative trading like spoofing can cause a permanent price impact to persist even after the manipulative trades are “unwound” through subsequent trades to realize profits. This is because of asymmetry in the nature of the

---

<sup>27</sup> In Nasdaq ITCH data, only non-marketable limit orders are included in the data—the marketable side of the order is simply reflected as an execution of the non-marketable order included in the data. The execution of limit orders by the Defendant thus reflects the execution of non-marketable orders by definition.

manipulative trades and the nature of the unwinding trades:

There is, however, no symmetry in the manipulative trade and its unwinding. A manipulative trader who wants, for example, to raise a price will buy in a way that maximizes the price impact. However, when unwinding the trade, that same trader will seek to minimize the price impact to avoid losses. Therefore, the upward effect can be expected to exceed the downward effect from unwinding—and that difference may represent a permanent effect.

136. Defendant engaged in asymmetric behavior that yielded an asymmetric price impact between manipulative Spoofing Episodes and the unwinding of their manipulative conduct. The total share volume of sell-side Baiting Orders exceeded the share volume of buy-side Executing Purchases by over **128-fold**. *Supra* ¶ 43 (83 million shares of Baiting Orders to 647 thousand shares of Executing Purchases during Spoofing Episodes). In addition, the median share volume of sell-side orders exceeded the median share volume of new buy-side orders placed during Spoofing Episodes by **145%**.<sup>28</sup> As such, the price impact of spoofed Baiting Orders was not fully unwound: the downward pressure applied by sell-side orders exceeded the upward pressure applied by buy-side orders. As Professor Milgrom explains, this difference between the sell-side and buy-side pressure yields a persistent and permanent price impact.

137. The “permanent price impact” that Professor Milgrom discussed as resulting from manipulative trading is established in the economic literature and is not limited to same-day effects.<sup>29</sup> For example, one heavily cited peer-reviewed study shows that “both ask and bid tend

---

<sup>28</sup> Over the two minutes prior to each Spoofing Episode, Defendant placed new sell-side orders for a median of 124,771 shares vs. 50,899 shares in new buy-side orders.

<sup>29</sup> Dr. Milgrom used the term “permanent price impact” to discuss an expert report previously submitted in that litigation by Dr. Craig Pirrong, which described peer-reviewed literature *that found the price impact of market manipulation lasted for more than one day*. Expert Report of Dr. Craig Pirrong, *Alaska Electrical Pension Fund v. Bank of America*, No. 14 Civ. 7126 (JMF)(S.D.N.Y.), ECF No. 503-4, Aug. 2, 2017, at \*22 n. 14 (“Carole Comerton-Forde and Talis J. Putnins, *Measuring Closing Price Manipulation*, 20 J. FIN. INTERMEDIATION (2011) 135, present empirical evidence on the price effects of 184 manipulations of the closing prices on US

to significantly increase (decrease) after the arrival of a buy (sell) limit order,” “quotes converge to a (new) permanent level” and “large volumes overbidding the prevailing quote cause a long-term upward movement of the bid.”<sup>30</sup>

138. The following Section describes specific examples of dates on which Plaintiff sold shares in the seconds and minutes following Defendant’s spoofing activity and explains how Defendant’s spoofing activity drove down the price of PHUN shares on those dates, causing Plaintiff to sell shares at artificially depressed prices.

### **1. January 26, 2021**

139. As listed in Exhibit 2, Plaintiff sold a total of 1,940,000 shares of PHUN on January 26, 2021. Among those sales included sale transactions at 09:30:01.265am and 09:30:04.381am, which were seconds after spoofing activity by Defendant just after the opening of trading that day that culminated in an Executing Purchase at 09:30:02.620695849am at a price of \$2.14 per share. Just prior to that spoofing activity, at 9:26am (during pre-market trading), the price of PHUN shares was \$2.23 per share. Defendant’s Executing Purchase thus occurred at a decline of 4% from the pre-spoofing price. From 09:30:01.265am to 09:30:51.329am, Plaintiff sold 36,157 shares of PHUN at prices ranging from \$2.12 to \$2.22 per share—a decline of as much as 5% from the pre-spoof level. Defendant’s spoofing activity caused Plaintiff to suffer losses by selling shares at prices artificially depressed by that activity, notwithstanding the partial reversion of the share price from \$2.12 to \$2.22 per share over that time interval.

---

and Canadian stock exchanges. During these manipulations, traders bought large quantities of stock shortly before the close. Comerton-Forde and Putnins find that (a) stock prices rose significantly at the close, and (b) the increases were only partially reversed the next day. The fact that the reversals were only partial indicates that the manipulations had a permanent effect on prices.”) (emphasis added).

<sup>30</sup> Nikolaus Hautsch & Ruihong Huang, *The Market Impact of a Limit Order*, 36 J. ECON. DYN. & CNTRL 501, 511, 5134 (2012).



140. While PHUN's share price partially recovered shortly thereafter, the recovery was brief, and the price continued to decline as a result of Defendant's spoofing activity. From 10:12:06.747am—less than 45 minutes after Defendant's Baiting Orders—to 11:18:13.697am that day, Plaintiff sold an additional 1,313,464 shares at artificially depressed prices as low as \$1.94 per share.

141. PHUN's share price decline on January 26, 2021, cannot be explained by other company-specific facts, circumstances or events. A search of news databases and SEC filings on Factiva shows that there was no corporate news or disclosures which could explain the price decline on the morning of January 26, 2021. There were no SEC filings in the days immediately before and after January 26, and there were no corporate disclosures that day. The Company's chief operating officer spoke at an investors' forum at 1:00pm Eastern Time that day, but that was long after the price decline had already occurred.

142. Nor can PHUN's share price decline on January 26, 2021, be explained by other industry-specific or market-wide facts, circumstances or events. On January 26, 2021, the Nasdaq Composite Index finished the day approximately flat, and intraday price movements were insignificant. The Nasdaq-100 Technology Index declined by 1% that day, and the price change from 9:30am to 11:30am was a decline on the order of 0.58%. By contrast, the decline in the price of PHUN shares over that window was approximately 5.9%—more than 10 times as large as the decline of the Nasdaq-100 Technology Index.

143. The decline in PHUN's share price on January 26, 2021, was not caused by the sale of shares by Plaintiff. If Plaintiff were driving down the price of PHUN shares by selling those shares, successive sales would have occurred at declining prices. However, that day, **over 94%** of sales by the Plaintiff were made **at the same or higher price** as the preceding sale.

## 2. October 26, 2021<sup>31</sup>

144. As listed in Exhibit 2, Plaintiff sold a total of 5,394,697 shares of PHUN on October 26, 2021. Among those sales included a sale transaction at 09:33:24.670265am, which was three minutes after a slew of spoofing activity by Defendant just after the opening of trading that day that culminated in *thirty-seven (37)* Executing Purchases by Defendant from 09:30:01.123261am to 09:30:10.348146am. Just prior to that spoofing activity, at 9:28:03am (during pre-market trading), the price of PHUN shares was \$6.86 per share. As noted *supra* ¶ 59, at 09:30:04.427209am, Defendant took advantage of this artificial downward pressure and executed Executing Purchases to buy a total of 50 shares, at a price of \$6.25 per share. Defendant's final Executing Purchase at 09:30:10.348146am occurred at a price of \$6.11 per share—a decline of 11% from the pre-spoofing price.

145. Unaware of Defendant's onslaught of spoofing activity that morning, Plaintiff continued to sell shares. Just three minutes later, at 09:33:24.670265am, Plaintiff sold 1,200 shares of PHUN at a price of \$6.29 per share—a decline of 8.3% from the pre-spoof level. Defendant's spoofing activity caused Plaintiff to suffer losses by selling shares at prices artificially depressed by that activity, notwithstanding the partial reversion of the price from \$6.11 to \$6.29 per share.<sup>32</sup> Within the first *fifteen minutes* of Defendant's spoofing—from 09:33:24.670266am to 09:44:08.660946am—Plaintiff sold a total of **1,162,063** shares at prices as high as \$6.485 per share—still well below the pre-spoof price, but high enough to yield Defendant a profit from

---

<sup>31</sup> Defendant also engaged in spoofing on (1) October 21, 2021, and Plaintiff sold 8 million shares of its stock that same day, and (2) October 27, 2021, and Plaintiff sold over 2.7 million shares of its stock that same day (*supra* ¶¶ 62-68), at prices that would have been higher, but for the negative price impact of Defendant's spoofing, *see* Exhibits 1 and 2.

<sup>32</sup> Moreover, as noted *supra* in ¶ 61, Defendant also sold 20 shares at a price of \$6.40 per share at 09:30:21am on October 26, 2021, which would have generated a return of 2.40% on Defendant's Executing Purchases at the artificially depressed price of \$6.25 per share.

Executing Purchases at prices such as \$6.11 and \$6.25 per share—to as low as \$5.70 per share. Defendant’s spoofing activity induced a crash in the price of PHUN shares on October 26, 2021. Within *one hour* of Defendant’s spoofing—from 09:33:24.670266am to 10:07:27.655291am—Plaintiff sold a total of **3,665,871** shares at prices as low as \$4.51. The price of PHUN shares never recovered to its pre-spoof level that day, causing the remainder of Plaintiff’s sales that day to occur at prices artificially depressed by Defendant’s spoofing.

146. Neither the disclosure of Plaintiff’s sales nor the sales themselves explain the price decline on October 26, 2021. These sales on October 26, 2021, were made pursuant to an “at-the-market offering” after a substantial price increase the preceding trading day. As required under the federal securities laws, Plaintiff had previously disclosed that it entered into an At Market Issuance Sales Agreement dated April 7, 2021 with B. Riley Securities, Inc. Sales of shares of common stock on October 26, 2021, were made pursuant to that agreement. The market reaction to the disclosure of the agreement via a Form 424B5 filing at 17:26:41 on April 7, 2021, was flat: the price of PHUN shares was \$1.99 per share one hour before that disclosure, \$2.00 immediately after that disclosure, and ended the day at \$1.96, demonstrating that the market did not view Plaintiff’s at-the-market offering negatively.

147. PHUN’s share price decline on October 26, 2021, cannot be explained by other company-specific facts, circumstances or events. A search of news databases and SEC filings on Factiva shows that there was no corporate news or disclosures which could explain the price decline on the morning of October 26, 2021. There were no SEC filings in the days immediately before and after October 26, 2021, and there were no corporate disclosures that day. The first Reuters publication on the Company’s at-the-market offering occurred at 9:33am, well after much of the price decline had already occurred. Later that day, news reports were written on the price

decline that day, which noted the Company's sale of shares, notwithstanding the absence of any market reaction to the announcement of the sale itself. Defendant's manipulative spoofing deceived not only Plaintiff but the news media as well regarding the true cause of the decline in the price of PHUN shares.

148. Media reports that day noted that PHUN's share price declined alongside the share price of Digital World Acquisition Company (DWAC), a special purpose acquisition company (SPAC) linked to Donald J. Trump, as Plaintiff's technology had been utilized by the Donald J. Trump 2020 presidential campaign. Notwithstanding media reports suggesting that the price changes on October 26, 2021, were explained by anti-Trump sentiment, the decline in PHUN's share price caused by Defendant's spoofing was in fact not explained by common anti-Trump sentiment driving changes in the price of DWAC and PHUN shares. From 9:28am to 9:33am—the period during which Defendant's spoofing activity drove down the price of PHUN to a low of a decline of 11% over that period, the price of DWAC generally *increased*, at one point reaching a peak *increase* of 4% over that same period relative to its level at 9:28am. Plaintiff's sales at 9:33am thus could not be explained by common sentiment driving the price of DWAC and PHUN shares. And while the price of DWAC did subsequently decline over the following hour, by 10:07:27.655291am—when Plaintiff had sold a total of **3,665,871** shares—the decline in PHUN's share price was nearly ***twice as large*** as the decline in DWAC (-34% vs. -18%). The decline in DWAC's share price thus did not explain the entire decline in PHUN's share price.

149. The decline in PHUN's share price on October 26, 2021, was also not caused by the sale of shares by Plaintiff. If Plaintiff were driving down the price of PHUN shares by selling those shares, successive sales would occur at declining prices. However, that day, ***over 90%*** of sales by the Plaintiff were made ***at the same or higher price*** as the preceding sale.

### 3. February 12, 2021

150. On February 3, 2021, Phunware filed a Registration Statement on Form S-3 (Registration No. 333-252694) with the SEC, pursuant to Rule 415 promulgated under the Securities Act of 1933, to register, among other things, the offering and sale of up to \$100,000,000 in share of Phunware's common stock, par value \$0.0001 per share. On February 7, 2021, Phunware announced that it was launching a proposed public offering of securities and that the price for the offering would be "subject to market and other conditions."<sup>33</sup>

151. On February 11, 2021, Phunware's Board voted to approve a public offering and sale of shares of Phunware common stock with an aggregate market value of up to \$25,000,000 out of the securities registered pursuant to the Registration Statement at such price and under such terms as may be approved by a Pricing Committee of Phunware's Board (the "Offering").

152. That same day, Phunware's Board established a duly formed Pricing Committee for the Offering. Among other things, the Pricing Committee was established to "determine the price or prices at which such shares of Common Stock are to be sold in the Offering," and the "terms and conditions of connection with the Offering."

153. At 14:34:57 on February 11, 2021, Phunware filed a request that its Registration Statement be "declared effective at 3:00 p.m. Eastern Time on February 11, 2021, or as soon thereafter as is practicable."<sup>34</sup>

154. Seeing an opportunity to enrich itself at Phunware's expense due to the Offering, Defendant thereafter engaged in spoofing activity that affected the closing price of PHUN shares

---

<sup>33</sup> <https://finance.yahoo.com/news/phunware-launches-proposed-public-offering-121200311.html>

<sup>34</sup> <https://www.sec.gov/Archives/edgar/data/1665300/000162828021001931/0001628280-21-001931-index.htm>

on February 11, 2021, and thus affected the price at which PHUN sold shares in the Offering.<sup>35</sup> During just the final ten minutes of that trading day, Defendant placed attributed Baiting Orders to sell 107,712 shares —over \$1.6 million in value—at a wide range of prices. By comparison, during the entire rest of the trading day, Defendant created attributed sell-side orders for only 2,800 shares. That is, over a period lasting less than ten minutes at the end of the trading day, Defendant placed more than 38 times the volume of attributed sell-side orders that it had placed throughout the entire rest of that trading day. These Baiting Orders created an imbalanced order book position among attributed orders favoring the sell side, with the share volume of newly created sell-side order volume exceeding the share volume of newly created buy-side order volume during this period by 73%. During this period, Defendant did not sell any shares of PHUN in attributed orders, consistent with the fictitious nature of the Baiting Orders.

155. The Baiting Orders successfully induced the entry of sell orders from other market participants, driving the price of PHUN shares downward by 1.7% over this ten-minute period, from a high of \$2.87 to a low of \$2.82 over this period. During this period, Defendant took advantage of this artificial downward pressure and executed Executing Purchases to buy a total of 4,014 shares, in three transactions of 3,414, 100 and 500 shares at 15:51:47.713, 15:56:17.667 and 15:56:20.163, respectively, at prices between \$2.84 and \$2.85 per share. The asymmetric

---

<sup>35</sup> This spoofing activity is not included in Exhibit 1. The methodology used to identify this spoofing activity is consistent with the methodology utilized by the government and accepted by courts to analyze loss causation in spoofing cases. *See, e.g.*, Declaration of Kumar Venkataraman, *U.S. v. Smith*, No. 19-CR-000669 (E.D. Ill., Dec. 22, 2022) (enclosed as Exhibit 4) (“while the conduct described by the DOJ’s witnesses at trial was focused on instances where the spoof orders directly benefited the Defendants by successfully triggering executions on their smaller orders, the Spoofing Sequences here also include spoof orders that caused harm to the rest of the market even though they did not directly benefit the Defendants’ smaller orders.”); Order, *U.S. v. Smith*, 19-CR-000669, ECF No. # 909 (E.D. Ill., Aug. 21, 2023) (enclosed as Exhibit 5) (“The Spoofing Sequences need not fit exactly the trial-evidence sequences; instead, the key features should (and do) remain intact.”).

downward pressure created by these Baiting Orders far exceeded the upward pressure arising from Defendant UBS's buy-side orders and Executing Purchases.

156. Trading in PHUN shares closed at 4:00pm, the time when a closing price would be determined and Phunware's Offering would be priced. Within milliseconds after the 4pm close of trading on February 11, 2021, Defendant began to cancel the artificial supply injected by these Baiting Orders. In just three minutes, from 16:00:00.397 to 16:00:03.277, Defendant cancelled all 107,712 shares in sell-side Baiting Orders that had been previously injected into the market (as well as 59,340 shares in buy-side orders), eliminating the artificial sell-side imbalance that had been falsely conveyed and injected into the market. As a result of Defendant's spoofing activity, Phunware's stock price fell from a closing price of \$3.04 on February 10, 2021, to \$2.81 on February 11, 2021, or more than 7.5%. Following the close of the market on February 11, 2021, Defendant's spoofing continued to cause Phunware's stock price to fall. While the price attempted to rebound, it ultimately reached a low of \$2.41 at 6:13:25am on February 12, 2021.

157. On February 11, 2021, following the close of the market, the Pricing Committee and then the Board priced the offering at \$2.25 per share. The \$2.25 price per share for the Offering reflected a 20% discount to the closing share price of Phunware on February 11, 2021, a fact noted by news reports issued on February 12, 2021, and was selected based on the price of Phunware's shares following the close of the market on February 11, 2021.

158. On February 12, 2021, at 6:00am Phunware issued a press release announcing that it would be commencing the Offering previously announced.

159. One hour later, at 7:00am, Phunware issued a press release announcing that the Offering would be priced at \$2.25 per share. That press release noted that the gross proceeds to the Company from the Offering, before deducting underwriting discounts and offering expenses

payable by the Company, were expected to be approximately \$25 million.

160. Plaintiff sold 11.7 million shares of PHUN stock in the Offering on February 12, 2021 at prices negatively impacted by Defendant's spoofing in the final minutes of the market open on February 11, 2021.

161. If Defendant had not spoofed Phunware's stock from 3:50pm to 4:00pm on February 11, 2021, the 4pm closing price of Phunware's shares would have been higher on February 11, 2021. If Phunware's 4pm closing price was higher on February 11, 2021, the price for the Offering would have been higher than \$2.25 per share, and Phunware would have received more than \$25 million in gross proceeds from the Offering.

162. The decline in Phunware's stock price on February 11, 2021 used to price the Offering, cannot be explained by other company-specific facts, circumstances or events. A search of news databases and SEC filings on Factiva shows that there was no corporate news or disclosures which could explain the price decline on that date. There was no new public information about Phunware in the market disclosed on that date.

\* \* \*

163. For all these reasons, while each Spoofing Episode had a small negative impact on the price of PHUN shares, the placement and cancellation of Baiting Orders throughout the Relevant Period had the cumulative effect of driving PHUN's share price down during the Relevant Period.

164. Defendant's wrongful conduct proximately caused Plaintiff's losses that Plaintiff suffered when the market price of PHUN shares was being driven downward.

**VI. THE MARKET FOR PHUN WAS EFFICIENT DURING THE RELEVANT PERIOD**

165. During the Relevant Period, the market for PHUN was an efficient market for the



following reasons, among others:

- a. As a regulated issuer, PHUN filed periodic public reports with the SEC;
- b. PHUN shares traded on Nasdaq;
- c. PHUN shares traded at high weekly trading volumes;
- d. PHUN filed registration statements with the SEC on Form S-3;
- e. The market reacted promptly to public information disseminated by PHUN;
- f. PHUN regularly communicated with public investors via established market communication mechanisms, including regular disseminations of press releases on the national circuits of major newswire services and other public disclosures, such as communications with the financial press and other similar reporting services; and
- g. PHUN was regularly covered throughout the Relevant Period by financial analysts, including HC Wainwright, Roth Capital, Taglich Brothers and Ascendant, as well as in the financial news.

166. As a result of the foregoing, the market for PHUN's shares promptly digested current information regarding PHUN from all publicly available sources and reflected such information in the price of PHUN's shares.

## **VII. CLAIMS FOR RELIEF**

### **A. First Claim for Relief for Spoofing in Violation of Section 10(b) of the Exchange Act of 1934 and Rule 10b-5(a) and (c) Promulgated Thereunder**

167. Plaintiff incorporates by reference paragraphs 1 through 166 as if more fully set forth herein.

168. During the Relevant Period, Defendant engaged in and employed devices, schemes, illegal acts, practices, and courses of conduct, that were intended to manipulate the market price

of PHUN shares that were listed and traded on Nasdaq, and which operated as a fraud and deceit upon Plaintiff.

169. As a direct and proximate result of Defendant's wrongful conduct, Plaintiff suffered damages in that it sold PHUN shares at manipulative prices, in reliance on an assumption of an efficient market free of manipulation. Plaintiff would not have sold shares at the prices sold if it had been aware of Defendant's manipulative and otherwise wrongful conduct that artificially and negatively affected the prices of PHUN shares.

**B. Second Claim for Relief for Spoofing in Violation of Section 9(a)(2) of The Securities Exchange Act of 1934**

170. Plaintiff incorporates by reference paragraphs 1 through 166 as if more fully set forth herein.

171. Based upon the conduct described above, Defendant's manipulative scheme violated Section 9(a)(2) of the Securities Exchange Act of 1934, which makes it unlawful to engage in a series of manipulative transactions "in any security . . . creating actual or apparent active trading in such security, or raising or depressing the price of such security, for the purpose of inducing the purchase or sale of such security by others."

172. By reason of the conduct described above, Defendant directly used the mails, or instrumentalities of interstate commerce, or a facility of a national securities exchange, to effect alone or with one or more other persons, a series of transactions in PHUN shares that created actual or apparent trading in such securities or raising or depressing the price of such securities for the purpose of inducing the purchase or sale of such securities by others, engaged in the market manipulation strategy of spoofing which artificially affected the prices of PHUN shares that Plaintiff sold.

173. Defendant's conscious misbehavior or recklessness artificially affected the price of

PHUN shares that Plaintiff sold during the Relevant Period. Plaintiff's financial injuries would not have been as extensive but for the Defendant's conscious misbehavior or recklessness.

**C. Third Claim for Relief for New York Common Law Fraud**

174. Plaintiff incorporates by reference paragraphs 1 through 166 as if more fully set forth herein.

175. By placing and then cancelling Baiting Orders in its abusive spoofing scheme, Defendant knowingly or recklessly injected into the market false and misleading information concerning the fake supply of PHUN shares that appeared available for trading. This interfered with the natural market forces of supply and demand and artificially drove the price of the shares downward. When Plaintiff sold its PHUN shares during the Relevant Period, it suffered damages that were directly and proximately caused by Defendant's fraud.

176. When Plaintiff sold its PHUN shares during the Relevant Period, it did not possess any specific facts demonstrating that the market price of PHUN stock was being manipulated and therefore, it relied on the efficiency of the market that had been unlawfully manipulated it suffered damages that were directly and proximately caused by Defendant's fraud. As a result, Plaintiff suffered financial losses that were directly and proximately caused by the Defendant's fraud.

**D. Fourth Claim for Injunctive Relief**

177. Plaintiff incorporates by reference paragraphs 1 through 166 as if more fully set forth herein.

178. Plaintiff seeks to permanently enjoin Defendant from engaging in spoofing conduct that affects the PHUN share price. Defendant's actions identified herein have caused, continue to cause, and will cause future permanent and irreparable harm to Plaintiff.

179. The balance of the equities favors an injunction to prevent Defendant from

continuing to spoof PHUN stock. The harm to Plaintiff is significant. In contrast, the potential harm to Defendant of an injunction is insignificant; Defendant would merely be required to halt its illegal activity. Thus, the public interest is best served by enjoining Defendant's spoofing behavior.

180. As noted throughout this Complaint, it is extremely likely that Plaintiff will succeed on the merits in this case. All evidence to be presented, including trading records and Defendant's own trading algorithms, will support the position that Defendant was manipulating the PHUN share price through spoofing.

181. As such, this Court should enter a permanent injunction enjoining Defendant from engaging in spoofing activities and any other illegal manipulative conduct that affects the PHUN share price.

#### **VIII. PRAYER FOR RELIEF**

WHEREFORE, Plaintiff respectfully requests that this Court enter a judgment:

- A. Finding that Defendant violated the federal securities and New York state laws as alleged in this Complaint;
- B. Ordering Defendant to pay damages as a result of its unlawful conduct in an amount to be determined at trial;
- C. Ordering permanent injunctive relief as described herein;
- D. Awarding reasonable attorneys' fees and costs together with all available pre and post judgment interest; and
- E. Granting such other and further relief as the Court deems just and appropriate.

#### **IX. DEMAND FOR JURY TRIAL**

Pursuant to Rule 38 of the Federal Rules of Civil Procedure, the Plaintiff demands trial by

jury in this action of all issues so triable.

Dated: April 17, 2024  
New York, New York

Respectfully submitted,

By: Laura H. Posner

Laura H. Posner  
Michael B. Eisenkraft  
COHEN MILSTEIN SELLERS & TOLL PLLC  
88 Pine Street, 14<sup>th</sup> Floor  
New York, New York 10005  
Tel: (212) 838-7797  
Fax: (212) 838-7745  
[lposner@cohenmilstein.com](mailto:lposner@cohenmilstein.com)  
[meisenkraft@cohenmilstein.com](mailto:meisenkraft@cohenmilstein.com)

Raymond M. Sarola (RS1010)  
Cohen Milstein Sellers & Toll PLLC  
100 N. 18<sup>th</sup> Street, Suite 1820  
Philadelphia, PA 19103  
Tel: (267) 479-5700  
Fax: (267) 479-5701  
[rsarola@cohenmilstein.com](mailto:rsarola@cohenmilstein.com)

*Counsel for Plaintiff*

# Exhibit 1

**Exhibit 1: Defendant's Spoofing Activities During Relevant Period**

Date	Executing Purchase			Best Offer (NBBO Quote)	Baiting Orders			Price Decline <sup>1</sup>	Prior Sale by Defendant <sup>2</sup>		Next Sale by Defendant <sup>2</sup>	
	Time	Volume	Price <sup>3</sup>		Volume <sup>4</sup>	Min. Price <sup>5</sup>	Max. Price <sup>5</sup>		Time	Price	Time	Price
1/5/21	09:31:05.384882503	2,107	\$1.19	\$1.20	268,319	\$1.28	\$200.00	-6.42%			01/08/21 at 15:55:37.239250949	\$1.34
1/5/21	09:31:07.463685901	3	\$1.17	\$1.18	268,319	\$1.28	\$200.00	-6.42%			01/08/21 at 15:55:37.239250949	\$1.34
1/5/21	09:31:37.493919055	1,000	\$1.15	\$1.16	268,419	\$1.28	\$200.00	-6.42%			01/08/21 at 15:55:37.239250949	\$1.34
1/11/21	09:30:00.997594715	43	\$1.22	\$1.24	100	\$1.30	\$1.58	-2.42%	01/08/21 at 15:55:37.239250949	\$1.34	01/14/21 at 15:57:06.883463569	\$1.32
1/11/21	09:30:00.997613086	100	\$1.22	\$1.24	100	\$1.30	\$1.58	-2.42%	01/08/21 at 15:55:37.239250949	\$1.34	01/14/21 at 15:57:06.883463569	\$1.32
1/11/21	09:30:00.997626631	100	\$1.22	\$1.24	100	\$1.30	\$1.58	-2.42%	01/08/21 at 15:55:37.239250949	\$1.34	01/14/21 at 15:57:06.883463569	\$1.32
1/11/21	09:30:01.004604904	67	\$1.22	\$1.24	100	\$1.30	\$1.58	-2.42%	01/08/21 at 15:55:37.239250949	\$1.34	01/14/21 at 15:57:06.883463569	\$1.32
1/11/21	09:30:06.777477414	100	\$1.22	\$1.24	6,211	\$1.30	\$1.58	-2.42%	01/08/21 at 15:55:37.239250949	\$1.34	01/14/21 at 15:57:06.883463569	\$1.32
1/14/21	09:31:27.831249413	20	\$1.24	\$1.26	100	\$1.61	\$1.61	-3.94%	01/08/21 at 15:55:37.239250949	\$1.34	01/14/21 at 15:57:06.883463569	\$1.32

<sup>1</sup> The “Price Decline” is the peak-to-trough percentage change in the price of executed transactions, *i.e.*,  $\frac{x}{y} - 1$ , where  $x$  is the lowest transaction price over the two minutes preceding the Executing Purchase to the two minutes following the Executed Purchase and  $y$  the highest transaction price over the two minutes preceding the Executing Purchase.

<sup>2</sup> The “prior sale by defendant” and “next sale by defendant” columns show sales attributable to the Defendant at a price higher than the Executing Purchase before and after, respectively, the Executing Purchase.

<sup>3</sup> For each of these, the price of the Executing Purchase is below the calculated best offer immediately prior to the Executing Purchase.

<sup>4</sup> The volume of Baiting Orders for a Spoofing Episode is defined as the lesser of the volume of sell-side orders cancelled in the two minutes after the Executing Purchase and the volume of sell-side orders created in the two minutes prior to the Executing Purchase (*i.e.*, the sell-side orders cancelled within two minutes after the Executing Purchase whose aggregate volume was created within the two minutes prior to the Executing Purchase).

<sup>5</sup> The market impact of a Baiting Order is the same regardless of whether Defendant cancelled that specific Baiting Order or another order placed by Defendant on Nasdaq. For this reason, prices for Baiting Orders reflect those orders cancelled after an Executing Purchase.

Date	Executing Purchase			Best Offer (NBBO Quote)	Baiting Orders			Price Decline <sup>1</sup>	Prior Sale by Defendant <sup>2</sup>		Next Sale by Defendant <sup>2</sup>	
	Time	Volume	Price <sup>3</sup>		Volume <sup>4</sup>	Min. Price <sup>5</sup>	Max. Price <sup>5</sup>		Time	Price	Time	Price
1/19/21	09:34:40.337161350	270	\$1.27	\$1.28	100	\$1.62	\$1.63	-4.58%	01/15/21 at 15:55:57.289036395	\$1.34	01/25/21 at 09:30:19.318715098	\$1.46
1/19/21	09:34:40.337161350	5,000	\$1.27	\$1.28	100	\$1.62	\$1.63	-4.58%	01/15/21 at 15:55:57.289036395	\$1.34	01/25/21 at 09:30:19.318715098	\$1.46
1/26/21	09:30:02.620695849	100	\$2.14	\$2.16	1,275	\$2.26	\$3.13	-3.21%	01/26/21 at 09:30:02.339316567	\$2.15	01/26/21 at 09:30:04.329735837	\$2.20
1/28/21	09:30:05.492499721	500	\$1.57	\$1.59	100	\$1.59	\$1.59	-1.89%	01/28/21 at 09:30:05.162134936	\$1.59	01/28/21 at 10:42:47.481475087	\$1.60
1/28/21	09:30:05.492499721	111	\$1.57	\$1.59	100	\$1.59	\$1.59	-1.89%	01/28/21 at 09:30:05.162134936	\$1.59	01/28/21 at 10:42:47.481475087	\$1.60
1/28/21	10:48:18.924077113	1,100	\$1.65	\$1.66	485	\$1.68	\$1.68	-2.99%	01/26/21 at 15:59:16.246121225	\$1.81	01/28/21 at 11:03:02.187755809	\$1.69
1/28/21	11:18:11.224229153	55	\$1.65	\$1.65	200	\$1.79	\$2.12	-4.05%	01/28/21 at 11:03:42.257888195	\$1.75	01/28/21 at 12:13:58.763771138	\$1.70
1/28/21	13:36:06.129860035	10	\$1.73	\$1.74	2,000	\$1.74	\$1.75	-0.57%	01/28/21 at 12:45:12.840350865	\$1.80	01/28/21 at 13:37:57.037157006	\$1.75
1/28/21	14:13:52.314483792	774	\$1.75	\$1.76	403	\$1.76	\$2.24	-2.84%	01/28/21 at 13:55:15.576127495	\$1.79	01/29/21 at 09:45:07.523456276	\$1.77
1/28/21	14:13:52.314557843	26	\$1.75	\$1.76	403	\$1.76	\$2.24	-2.84%	01/28/21 at 13:55:15.576127495	\$1.79	01/29/21 at 09:45:07.523456276	\$1.77
1/28/21	14:17:10.675752126	20	\$1.71	\$1.72	100	\$2.20	\$2.20	-4.02%	01/28/21 at 13:55:15.576127495	\$1.79	01/29/21 at 09:45:06.394600526	\$1.75
1/28/21	14:17:10.675752126	1,000	\$1.71	\$1.72	100	\$2.20	\$2.20	-4.02%	01/28/21 at 13:55:15.576127495	\$1.79	01/29/21 at 09:45:06.394600526	\$1.75
1/28/21	14:17:10.675752126	372	\$1.71	\$1.72	100	\$2.20	\$2.20	-4.02%	01/28/21 at 13:55:15.576127495	\$1.79	01/29/21 at 09:45:06.394600526	\$1.75
1/28/21	15:45:58.844736711	100	\$1.62	\$1.63	100	\$1.80	\$1.80	-1.21%	01/28/21 at 15:11:29.115284423	\$1.68	01/29/21 at 09:37:26.565153790	\$1.70
1/29/21	09:32:16.453426572	300	\$1.71	\$1.72	100	\$2.22	\$2.22	-2.87%	01/28/21 at 13:55:15.576127495	\$1.79	01/29/21 at 09:45:06.394600526	\$1.75
1/29/21	09:39:47.234258115	40	\$1.65	\$1.66	400	\$1.70	\$1.70	-4.12%	01/29/21 at 09:37:26.565169526	\$1.70	01/29/21 at 09:43:21.652005821	\$1.71
1/29/21	09:39:47.234258115	1,872	\$1.65	\$1.66	400	\$1.70	\$1.70	-4.12%	01/29/21 at 09:37:26.565169526	\$1.70	01/29/21 at 09:43:21.652005821	\$1.71
1/29/21	09:45:56.877155272	1,000	\$1.76	\$1.77	1,150	\$1.80	\$2.40	-5.06%	01/29/21 at 09:45:07.523456276	\$1.77	01/29/21 at 09:47:47.163564150	\$1.79
1/29/21	09:45:56.877155272	100	\$1.76	\$1.77	1,150	\$1.80	\$2.40	-5.06%	01/29/21 at 09:45:07.523456276	\$1.77	01/29/21 at 09:47:47.163564150	\$1.79



Date	Executing Purchase			Best Offer (NBBO Quote)	Baiting Orders			Price Decline <sup>1</sup>	Prior Sale by Defendant <sup>2</sup>		Next Sale by Defendant <sup>2</sup>	
	Time	Volume	Price <sup>3</sup>		Volume <sup>4</sup>	Min. Price <sup>5</sup>	Max. Price <sup>5</sup>		Time	Price	Time	Price
1/29/21	10:08:28.654616933	580	\$1.86	\$1.87	1,440	\$1.88	\$2.40	-2.14%	01/29/21 at 10:05:09.496485415	\$1.90	01/29/21 at 10:13:34.913507981	\$1.88
1/29/21	10:08:35.014350092	10,553	\$1.86	\$1.87	340	\$1.88	\$2.40	-2.14%	01/29/21 at 10:05:09.496485415	\$1.90	01/29/21 at 10:13:34.913507981	\$1.88
1/29/21	10:08:35.014350092	400	\$1.86	\$1.87	340	\$1.88	\$2.40	-2.14%	01/29/21 at 10:05:09.496485415	\$1.90	01/29/21 at 10:13:34.913507981	\$1.88
1/29/21	10:15:05.952891169	352	\$1.90	\$1.91	15,498	\$1.91	\$2.08	-5.15%	01/29/21 at 10:14:56.679057133	\$1.92	01/29/21 at 10:16:46.183736468	\$1.91
1/29/21	10:15:05.952900443	10,448	\$1.90	\$1.91	15,498	\$1.91	\$2.08	-5.15%	01/29/21 at 10:14:56.679057133	\$1.92	01/29/21 at 10:16:46.183736468	\$1.91
1/29/21	10:15:06.231745085	248	\$1.88	\$1.89	15,498	\$1.91	\$2.08	-5.15%	01/29/21 at 10:14:56.679057133	\$1.92	01/29/21 at 10:16:46.183736468	\$1.91
1/29/21	10:15:20.997913998	4,776	\$1.89	\$1.89	7,936	\$1.91	\$2.20	-5.15%	01/29/21 at 10:14:56.679057133	\$1.92	01/29/21 at 10:16:46.183736468	\$1.91
1/29/21	10:23:35.579111907	200	\$2.01	\$2.02	14,150	\$2.00	\$2.54	-6.38%	01/29/21 at 10:23:00.866252817	\$2.04	01/29/21 at 15:39:49.758704549	\$2.02
1/29/21	10:31:58.446700065	3,600	\$1.95	\$1.96	4,879	\$1.90	\$2.98	-7.04%	01/29/21 at 10:23:06.281747240	\$2.01	01/29/21 at 15:39:32.013579920	\$1.96
1/29/21	10:32:12.945131787	54	\$1.94	\$1.95	4,979	\$1.90	\$2.98	-7.04%	01/29/21 at 10:23:06.281747240	\$2.01	01/29/21 at 15:37:56.442246624	\$1.95
1/29/21	10:32:23.720990736	100	\$1.93	\$1.94	4,979	\$1.90	\$2.98	-7.04%	01/29/21 at 10:23:06.281747240	\$2.01	01/29/21 at 15:34:34.329372048	\$1.94
1/29/21	10:32:54.665197048	45	\$1.89	\$1.90	5,229	\$1.90	\$2.98	-7.03%	01/29/21 at 10:23:06.281747240	\$2.01	01/29/21 at 10:40:27.262404340	\$1.90
1/29/21	10:33:32.737471837	80	\$1.86	\$1.87	4,319	\$1.90	\$2.75	-6.09%	01/29/21 at 10:23:06.281747240	\$2.01	01/29/21 at 10:40:27.262404340	\$1.90
1/29/21	10:34:52.965119371	409	\$1.89	\$1.90	740	\$2.75	\$2.75	-3.65%	01/29/21 at 10:23:06.281747240	\$2.01	01/29/21 at 10:40:27.262404340	\$1.90
1/29/21	10:34:52.965133462	2,400	\$1.89	\$1.90	740	\$2.75	\$2.75	-3.65%	01/29/21 at 10:23:06.281747240	\$2.01	01/29/21 at 10:40:27.262404340	\$1.90
1/29/21	10:34:52.965135789	400	\$1.89	\$1.90	740	\$2.75	\$2.75	-3.65%	01/29/21 at 10:23:06.281747240	\$2.01	01/29/21 at 10:40:27.262404340	\$1.90
1/29/21	10:34:52.965143830	1,244	\$1.89	\$1.90	740	\$2.75	\$2.75	-3.65%	01/29/21 at 10:23:06.281747240	\$2.01	01/29/21 at 10:40:27.262404340	\$1.90
1/29/21	10:34:52.965152544	9,953	\$1.89	\$1.90	740	\$2.75	\$2.75	-3.65%	01/29/21 at 10:23:06.281747240	\$2.01	01/29/21 at 10:40:27.262404340	\$1.90
1/29/21	10:41:21.633031332	707	\$1.87	\$1.88	17,950	\$1.87	\$2.40	-5.76%	01/29/21 at 10:40:27.262404340	\$1.90	01/29/21 at 15:31:15.185842311	\$1.90

Date	Executing Purchase			Best Offer (NBBO Quote)	Baiting Orders			Price Decline <sup>1</sup>	Prior Sale by Defendant <sup>2</sup>		Next Sale by Defendant <sup>2</sup>	
	Time	Volume	Price <sup>3</sup>		Volume <sup>4</sup>	Min. Price <sup>5</sup>	Max. Price <sup>5</sup>		Time	Price	Time	Price
1/29/21	10:41:21.633248548	2,093	\$1.87	\$1.88	17,950	\$1.87	\$2.40	-5.76%	01/29/21 at 10:40:27.262404340	\$1.90	01/29/21 at 15:31:15.185842311	\$1.90
1/29/21	10:48:10.514788243	140	\$1.80	\$1.81	1,242	\$1.83	\$2.06	-2.19%	01/29/21 at 10:47:00.555464918	\$1.81	01/29/21 at 15:19:13.744374187	\$1.82
1/29/21	11:22:56.165376787	1	\$1.74	\$1.75	1	\$1.78	\$1.78	-1.82%	01/29/21 at 10:58:37.175803320	\$1.79	01/29/21 at 11:43:36.512469520	\$1.77
1/29/21	11:28:36.431809122	1,144	\$1.75	\$1.76	4,000	\$1.81	\$1.82	-2.81%	01/29/21 at 10:58:37.175803320	\$1.79	01/29/21 at 11:43:36.512469520	\$1.77
1/29/21	11:29:04.600627471	1	\$1.74	\$1.75	1,600	\$1.81	\$1.82	-2.81%	01/29/21 at 10:58:37.175803320	\$1.79	01/29/21 at 11:43:36.512469520	\$1.77
1/29/21	12:22:52.747086582	100	\$1.71	\$1.72	100	\$1.99	\$1.99	-2.58%	01/29/21 at 11:56:15.856671972	\$1.78	01/29/21 at 15:18:12.758252048	\$1.78
1/29/21	12:39:17.328725990	645	\$1.65	\$1.66	100	\$1.78	\$1.78	-3.55%	01/29/21 at 11:56:15.856671972	\$1.78	01/29/21 at 12:40:20.181604116	\$1.67
1/29/21	12:39:17.328725990	10	\$1.65	\$1.66	100	\$1.78	\$1.78	-3.55%	01/29/21 at 11:56:15.856671972	\$1.78	01/29/21 at 12:40:20.181604116	\$1.67
1/29/21	12:39:17.328725990	1,000	\$1.65	\$1.66	100	\$1.78	\$1.78	-3.55%	01/29/21 at 11:56:15.856671972	\$1.78	01/29/21 at 12:40:20.181604116	\$1.67
1/29/21	12:39:30.643714099	1,000	\$1.63	\$1.64	100	\$1.78	\$1.78	-3.55%	01/29/21 at 11:56:15.856671972	\$1.78	01/29/21 at 12:40:20.181604116	\$1.67
1/29/21	15:18:37.636406336	10	\$1.78	\$1.79	5,000	\$1.77	\$2.30	-4.44%	01/29/21 at 11:49:42.598923776	\$1.80	01/29/21 at 15:19:13.734084339	\$1.80
1/29/21	15:18:37.683718452	490	\$1.78	\$1.79	5,000	\$1.77	\$2.30	-4.44%	01/29/21 at 11:49:42.598923776	\$1.80	01/29/21 at 15:19:13.734084339	\$1.80
1/29/21	15:21:51.323527234	1,000	\$1.77	\$1.78	3,213	\$1.80	\$2.00	-4.35%	01/29/21 at 15:19:54.431920494	\$1.83	01/29/21 at 15:22:09.348588897	\$1.81
1/29/21	15:21:51.325685612	100	\$1.76	\$1.77	3,213	\$1.80	\$2.00	-4.35%	01/29/21 at 15:21:44.754696532	\$1.77	01/29/21 at 15:22:09.348588897	\$1.81
1/29/21	15:22:37.828075153	150	\$1.85	\$1.86	3,525	\$1.80	\$2.44	-5.38%	01/29/21 at 10:40:27.262404340	\$1.90	01/29/21 at 15:30:29.537164668	\$1.87
1/29/21	15:23:01.305467116	9	\$1.84	\$1.85	3,059	\$1.80	\$2.44	-5.38%	01/29/21 at 15:22:24.771035147	\$1.85	01/29/21 at 15:30:29.537164668	\$1.87
1/29/21	15:23:01.305467116	400	\$1.84	\$1.85	3,059	\$1.80	\$2.44	-5.38%	01/29/21 at 15:22:24.771035147	\$1.85	01/29/21 at 15:30:29.537164668	\$1.87
1/29/21	15:23:10.750212419	200	\$1.82	\$1.83	3,525	\$1.80	\$2.44	-5.38%	01/29/21 at 15:22:24.771035147	\$1.85	01/29/21 at 15:30:29.537164668	\$1.87
1/29/21	15:23:10.750287181	800	\$1.82	\$1.83	3,525	\$1.80	\$2.44	-5.38%	01/29/21 at 15:22:24.771035147	\$1.85	01/29/21 at 15:30:29.537164668	\$1.87

Date	Executing Purchase			Best Offer (NBBO Quote)	Baiting Orders			Price Decline <sup>1</sup>	Prior Sale by Defendant <sup>2</sup>		Next Sale by Defendant <sup>2</sup>	
	Time	Volume	Price <sup>3</sup>		Volume <sup>4</sup>	Min. Price <sup>5</sup>	Max. Price <sup>5</sup>		Time	Price	Time	Price
1/29/21	15:23:23.257804052	600	\$1.78	\$1.79	2,325	\$1.80	\$2.44	-5.38%	01/29/21 at 15:22:24.771035147	\$1.85	01/29/21 at 15:23:43.919873609	\$1.80
1/29/21	15:23:55.833367448	40	\$1.80	\$1.81	1,728	\$1.82	\$2.44	-4.31%	01/29/21 at 15:22:24.771035147	\$1.85	01/29/21 at 15:30:29.537164668	\$1.87
1/29/21	15:33:11.782450854	200	\$1.90	\$1.91	6,045	\$1.92	\$2.25	-4.17%	01/29/21 at 15:31:42.877149750	\$1.91	01/29/21 at 15:34:00.806733560	\$1.91
1/29/21	15:35:12.924544154	500	\$1.92	\$1.93	4,500	\$1.98	\$2.25	-5.13%	01/29/21 at 15:34:34.329372048	\$1.94	01/29/21 at 15:37:53.857020594	\$1.94
1/29/21	15:40:10.657177137	5,000	\$1.98	\$1.99	3,818	\$1.94	\$2.50	-7.43%	01/29/21 at 15:40:04.158700499	\$1.99	01/29/21 at 15:44:58.174530028	\$1.99
1/29/21	15:40:11.853279973	100	\$1.95	\$1.96	3,818	\$1.94	\$2.50	-7.43%	01/29/21 at 15:40:04.158700499	\$1.99	01/29/21 at 15:43:11.174263970	\$1.97
1/29/21	15:40:34.452479009	500	\$1.95	\$1.96	2,818	\$1.94	\$2.50	-7.43%	01/29/21 at 15:40:04.158700499	\$1.99	01/29/21 at 15:43:11.174263970	\$1.97
1/29/21	15:41:47.421428946	42	\$1.91	\$1.91	8,165	\$1.95	\$2.35	-6.93%	01/29/21 at 15:40:17.004041498	\$1.95	01/29/21 at 15:42:29.515538077	\$1.95
1/29/21	15:42:28.374194819	500	\$1.96	\$1.97	8,165	\$1.95	\$2.35	-5.05%	01/29/21 at 15:40:04.158700499	\$1.99	01/29/21 at 15:43:11.174263970	\$1.97
1/29/21	15:42:28.374487925	1,596	\$1.96	\$1.97	8,165	\$1.95	\$2.35	-5.05%	01/29/21 at 15:40:04.158700499	\$1.99	01/29/21 at 15:43:11.174263970	\$1.97
1/29/21	15:42:28.374493844	1,197	\$1.96	\$1.97	8,165	\$1.95	\$2.35	-5.05%	01/29/21 at 15:40:04.158700499	\$1.99	01/29/21 at 15:43:11.174263970	\$1.97
1/29/21	15:42:28.374505639	111	\$1.96	\$1.97	8,165	\$1.95	\$2.35	-5.05%	01/29/21 at 15:40:04.158700499	\$1.99	01/29/21 at 15:43:11.174263970	\$1.97
1/29/21	15:42:28.516192030	100	\$1.95	\$1.96	8,165	\$1.95	\$2.35	-5.05%	01/29/21 at 15:40:04.158700499	\$1.99	01/29/21 at 15:43:11.174263970	\$1.97
1/29/21	15:45:37.165181729	500	\$1.97	\$1.98	13,100	\$2.02	\$3.09	-4.50%	01/29/21 at 15:44:58.174530028	\$1.99	01/29/21 at 15:46:00.018555719	\$1.98
1/29/21	15:45:39.192850588	100	\$1.96	\$1.97	13,100	\$2.02	\$3.09	-4.50%	01/29/21 at 15:44:58.174530028	\$1.99	01/29/21 at 15:46:00.018555719	\$1.98
1/29/21	15:47:57.883261425	11	\$2.04	\$2.05	80,369	\$2.08	\$4.22	-6.43%	01/29/21 at 15:47:28.764975958	\$2.09	01/29/21 at 15:48:03.150030932	\$2.06
1/29/21	15:47:57.892353076	20	\$2.04	\$2.05	80,369	\$2.08	\$4.22	-6.43%	01/29/21 at 15:47:28.764975958	\$2.09	01/29/21 at 15:48:03.150030932	\$2.06
1/29/21	15:47:57.935232054	969	\$2.04	\$2.05	80,369	\$2.08	\$4.22	-6.43%	01/29/21 at 15:47:28.764975958	\$2.09	01/29/21 at 15:48:03.150030932	\$2.06
1/29/21	15:51:00.948481204	1,250	\$2.22	\$2.23	25,636	\$2.15	\$52.17	-7.14%	01/29/21 at 15:50:45.380777252	\$2.23	02/01/21 at 09:35:23.563791579	\$3.15

Date	Executing Purchase			Best Offer (NBBO Quote)	Baiting Orders			Price Decline <sup>1</sup>	Prior Sale by Defendant <sup>2</sup>		Next Sale by Defendant <sup>2</sup>	
	Time	Volume	Price <sup>3</sup>		Volume <sup>4</sup>	Min. Price <sup>5</sup>	Max. Price <sup>5</sup>		Time	Price	Time	Price
1/29/21	15:51:07.878192733	1,000	\$2.19	\$2.20	23,836	\$2.15	\$52.17	-7.14%	01/29/21 at 15:50:45.380777252	\$2.23	01/29/21 at 15:51:10.834035229	\$2.21
2/1/21	09:30:02.644171282	420	\$3.09	\$3.10	450	\$3.40	\$3.98	-5.73%			02/01/21 at 09:35:23.563791579	\$3.15
2/1/21	09:30:02.644171282	1	\$3.09	\$3.10	450	\$3.40	\$3.98	-5.73%			02/01/21 at 09:35:23.563791579	\$3.15
2/1/21	09:30:02.644171282	1,500	\$3.09	\$3.10	450	\$3.40	\$3.98	-5.73%			02/01/21 at 09:35:23.563791579	\$3.15
2/1/21	09:30:02.644171282	30	\$3.09	\$3.10	450	\$3.40	\$3.98	-5.73%			02/01/21 at 09:35:23.563791579	\$3.15
2/1/21	09:30:02.644171282	3	\$3.09	\$3.10	450	\$3.40	\$3.98	-5.73%			02/01/21 at 09:35:23.563791579	\$3.15
2/1/21	09:30:02.644171282	10	\$3.09	\$3.10	450	\$3.40	\$3.98	-5.73%			02/01/21 at 09:35:23.563791579	\$3.15
2/1/21	09:30:02.651619949	1	\$3.08	\$3.10	450	\$3.40	\$3.98	-5.73%			02/01/21 at 09:35:23.563791579	\$3.15
2/1/21	09:30:02.651619949	50	\$3.08	\$3.10	450	\$3.40	\$3.98	-5.73%			02/01/21 at 09:35:23.563791579	\$3.15
2/1/21	09:30:02.651619949	20	\$3.08	\$3.10	450	\$3.40	\$3.98	-5.73%			02/01/21 at 09:35:23.563791579	\$3.15
2/1/21	09:30:02.651619949	20	\$3.08	\$3.10	450	\$3.40	\$3.98	-5.73%			02/01/21 at 09:35:23.563791579	\$3.15
2/1/21	09:30:02.651619949	4	\$3.08	\$3.10	450	\$3.40	\$3.98	-5.73%			02/01/21 at 09:35:23.563791579	\$3.15
2/1/21	09:30:02.651619949	11,363	\$3.08	\$3.10	450	\$3.40	\$3.98	-5.73%			02/01/21 at 09:35:23.563791579	\$3.15
2/1/21	09:30:02.651619949	30	\$3.08	\$3.10	450	\$3.40	\$3.98	-5.73%			02/01/21 at 09:35:23.563791579	\$3.15
2/1/21	09:30:08.650127928	10	\$3.07	\$3.09	450	\$3.40	\$3.98	-5.73%			02/01/21 at 09:35:23.563791579	\$3.15
2/1/21	09:30:08.650127928	1	\$3.07	\$3.09	450	\$3.40	\$3.98	-5.73%			02/01/21 at 09:35:23.563791579	\$3.15
2/1/21	09:30:08.650127928	100	\$3.07	\$3.09	450	\$3.40	\$3.98	-5.73%			02/01/21 at 09:35:23.563791579	\$3.15
2/1/21	09:30:08.650127928	3	\$3.07	\$3.09	450	\$3.40	\$3.98	-5.73%			02/01/21 at 09:35:23.563791579	\$3.15
2/1/21	09:30:08.717777041	8	\$3.06	\$3.08	450	\$3.40	\$3.98	-5.73%			02/01/21 at 09:35:23.563791579	\$3.15

Date	Executing Purchase			Best Offer (NBBO Quote)	Baiting Orders			Price Decline <sup>1</sup>	Prior Sale by Defendant <sup>2</sup>		Next Sale by Defendant <sup>2</sup>	
	Time	Volume	Price <sup>3</sup>		Volume <sup>4</sup>	Min. Price <sup>5</sup>	Max. Price <sup>5</sup>		Time	Price	Time	Price
2/1/21	09:36:53.527797150	100	\$2.91	\$2.92	100	\$4.00	\$4.00	-8.52%	02/01/21 at 09:35:23.563791579	\$3.15	02/01/21 at 10:01:09.120804476	\$2.94
2/1/21	09:39:49.667087089	2	\$2.88	\$2.89	100	\$3.71	\$3.71	-6.88%	02/01/21 at 09:35:23.563791579	\$3.15	02/01/21 at 09:46:03.083648969	\$2.90
2/1/21	09:40:42.623590119	100	\$2.86	\$2.87	100	\$3.70	\$3.71	-6.88%	02/01/21 at 09:35:23.563791579	\$3.15	02/01/21 at 09:46:03.083648969	\$2.90
2/1/21	09:40:42.623590119	200	\$2.86	\$2.87	100	\$3.70	\$3.71	-6.88%	02/01/21 at 09:35:23.563791579	\$3.15	02/01/21 at 09:46:03.083648969	\$2.90
2/1/21	09:52:47.263018539	690	\$2.75	\$2.76	3,200	\$2.84	\$3.60	-5.56%	02/01/21 at 09:51:41.211767217	\$2.79	02/01/21 at 09:53:20.255061174	\$2.80
2/1/21	09:52:47.804217483	500	\$2.72	\$2.73	3,300	\$2.84	\$3.60	-5.56%	02/01/21 at 09:51:41.211767217	\$2.79	02/01/21 at 09:53:20.255061174	\$2.80
2/1/21	09:54:14.772726340	10	\$2.80	\$2.81	6,172	\$2.80	\$3.60	-4.90%	02/01/21 at 09:46:03.083648969	\$2.90	02/01/21 at 09:57:29.033499270	\$2.82
2/1/21	09:54:14.775536875	3	\$2.76	\$2.77	6,072	\$2.80	\$3.54	-4.90%	02/01/21 at 09:53:20.255061174	\$2.80	02/01/21 at 09:56:13.956546488	\$2.80
2/1/21	09:54:14.776825880	3	\$2.75	\$2.76	6,072	\$2.80	\$3.54	-4.90%	02/01/21 at 09:53:20.255061174	\$2.80	02/01/21 at 09:56:13.956546488	\$2.80
2/1/21	09:54:14.776825880	727	\$2.75	\$2.76	6,072	\$2.80	\$3.54	-4.90%	02/01/21 at 09:53:20.255061174	\$2.80	02/01/21 at 09:56:13.956546488	\$2.80
2/1/21	09:54:35.365882501	700	\$2.74	\$2.75	6,195	\$2.80	\$3.54	-4.90%	02/01/21 at 09:53:20.255061174	\$2.80	02/01/21 at 09:55:36.565017653	\$2.75
2/1/21	09:54:47.435648239	25	\$2.73	\$2.74	4,718	\$2.80	\$3.54	-4.90%	02/01/21 at 09:53:20.255061174	\$2.80	02/01/21 at 09:55:36.565017653	\$2.75
2/1/21	09:54:47.437222317	150	\$2.72	\$2.73	4,618	\$2.80	\$3.40	-4.90%	02/01/21 at 09:53:20.255061174	\$2.80	02/01/21 at 09:55:36.565017653	\$2.75
2/1/21	09:54:47.437222317	500	\$2.72	\$2.73	4,618	\$2.80	\$3.40	-4.90%	02/01/21 at 09:53:20.255061174	\$2.80	02/01/21 at 09:55:36.565017653	\$2.75
2/1/21	09:54:51.127428422	70	\$2.74	\$2.75	4,618	\$2.80	\$3.40	-4.90%	02/01/21 at 09:53:20.255061174	\$2.80	02/01/21 at 09:55:36.565017653	\$2.75
2/1/21	09:59:41.085241203	392	\$2.85	\$2.86	11,367	\$2.88	\$3.09	-2.42%	02/01/21 at 09:57:40.180800043	\$2.89	02/01/21 at 10:00:30.693362653	\$2.87
2/1/21	09:59:41.201961757	312	\$2.85	\$2.86	11,367	\$2.88	\$3.09	-2.42%	02/01/21 at 09:57:40.180800043	\$2.89	02/01/21 at 10:00:30.693362653	\$2.87
2/1/21	09:59:41.201961757	300	\$2.85	\$2.86	11,367	\$2.88	\$3.09	-2.42%	02/01/21 at 09:57:40.180800043	\$2.89	02/01/21 at 10:00:30.693362653	\$2.87
2/1/21	10:01:54.173616993	10	\$2.89	\$2.90	3,804	\$2.90	\$3.25	-3.05%	02/01/21 at 10:01:30.243635354	\$2.94	02/01/21 at 10:02:08.096207010	\$2.90

Date	Executing Purchase			Best Offer (NBBO Quote)	Baiting Orders			Price Decline <sup>1</sup>	Prior Sale by Defendant <sup>2</sup>		Next Sale by Defendant <sup>2</sup>	
	Time	Volume	Price <sup>3</sup>		Volume <sup>4</sup>	Min. Price <sup>5</sup>	Max. Price <sup>5</sup>		Time	Price	Time	Price
2/1/21	10:01:54.173616993	100	\$2.89	\$2.90	3,804	\$2.90	\$3.25	-3.05%	02/01/21 at 10:01:30.243635354	\$2.94	02/01/21 at 10:02:08.096207010	\$2.90
2/1/21	10:04:33.129607781	1	\$2.84	\$2.85	6,306	\$2.86	\$3.35	-6.00%	02/01/21 at 10:03:21.304777711	\$2.96	02/01/21 at 10:05:22.875588195	\$2.90
2/1/21	10:04:33.254381750	4	\$2.83	\$2.84	6,306	\$2.86	\$3.35	-6.00%	02/01/21 at 10:03:21.304777711	\$2.96	02/01/21 at 10:04:45.060696223	\$2.84
2/1/21	10:04:33.432159640	10	\$2.82	\$2.83	6,305	\$2.86	\$3.35	-6.00%	02/01/21 at 10:03:21.304777711	\$2.96	02/01/21 at 10:04:45.060696223	\$2.84
2/1/21	10:09:45.112173767	100	\$2.92	\$2.93	9,250	\$2.92	\$3.78	-3.04%	02/01/21 at 10:08:08.538589566	\$2.95	02/01/21 at 10:09:55.393449425	\$2.93
2/1/21	10:10:12.535958638	2,700	\$2.90	\$2.91	9,165	\$2.92	\$3.73	-3.04%	02/01/21 at 10:09:55.750188292	\$2.95	02/01/21 at 10:10:21.637925956	\$2.92
2/1/21	10:11:19.476207374	500	\$2.92	\$2.93	3,128	\$2.93	\$3.13	-3.04%	02/01/21 at 10:11:06.114740083	\$2.93	02/01/21 at 10:11:22.659291131	\$2.94
2/1/21	10:11:19.477229422	30	\$2.91	\$2.92	3,128	\$2.93	\$3.13	-3.04%	02/01/21 at 10:11:06.114740083	\$2.93	02/01/21 at 10:11:22.659291131	\$2.94
2/1/21	10:11:41.486845643	1,027	\$2.90	\$2.91	2,128	\$2.93	\$3.38	-3.04%	02/01/21 at 10:11:22.659291131	\$2.94	02/01/21 at 10:11:56.830815509	\$2.94
2/1/21	10:11:41.926473553	500	\$2.90	\$2.91	2,128	\$2.93	\$3.38	-3.04%	02/01/21 at 10:11:22.659291131	\$2.94	02/01/21 at 10:11:56.830815509	\$2.94
2/1/21	10:11:41.926647205	162	\$2.90	\$2.91	2,128	\$2.93	\$3.38	-3.04%	02/01/21 at 10:11:22.659291131	\$2.94	02/01/21 at 10:11:56.830815509	\$2.94
2/1/21	10:17:55.771906343	50	\$2.85	\$2.86	5,674	\$2.85	\$3.63	-4.45%	02/01/21 at 10:16:41.278482661	\$2.90	02/01/21 at 10:18:53.067307801	\$2.86
2/1/21	10:17:55.771906343	215	\$2.85	\$2.86	5,674	\$2.85	\$3.63	-4.45%	02/01/21 at 10:16:41.278482661	\$2.90	02/01/21 at 10:18:53.067307801	\$2.86
2/1/21	10:17:55.771950113	100	\$2.85	\$2.86	5,674	\$2.85	\$3.63	-4.45%	02/01/21 at 10:16:41.278482661	\$2.90	02/01/21 at 10:18:53.067307801	\$2.86
2/1/21	10:17:55.771952321	185	\$2.85	\$2.86	5,674	\$2.85	\$3.63	-4.45%	02/01/21 at 10:16:41.278482661	\$2.90	02/01/21 at 10:18:53.067307801	\$2.86
2/1/21	10:18:07.073528983	1	\$2.85	\$2.86	5,674	\$2.85	\$3.63	-4.45%	02/01/21 at 10:16:41.278482661	\$2.90	02/01/21 at 10:18:53.067307801	\$2.86
2/1/21	10:18:22.790190254	20	\$2.80	\$2.81	924	\$2.85	\$3.63	-4.45%	02/01/21 at 10:16:41.278482661	\$2.90	02/01/21 at 10:18:53.067307801	\$2.86
2/1/21	10:18:22.790190254	1,000	\$2.80	\$2.81	924	\$2.85	\$3.63	-4.45%	02/01/21 at 10:16:41.278482661	\$2.90	02/01/21 at 10:18:53.067307801	\$2.86
2/1/21	10:18:22.790190254	10	\$2.80	\$2.81	924	\$2.85	\$3.63	-4.45%	02/01/21 at 10:16:41.278482661	\$2.90	02/01/21 at 10:18:53.067307801	\$2.86

Date	Executing Purchase			Best Offer (NBBO Quote)	Baiting Orders			Price Decline <sup>1</sup>	Prior Sale by Defendant <sup>2</sup>		Next Sale by Defendant <sup>2</sup>	
	Time	Volume	Price <sup>3</sup>		Volume <sup>4</sup>	Min. Price <sup>5</sup>	Max. Price <sup>5</sup>		Time	Price	Time	Price
2/1/21	10:18:22.790190254	200	\$2.80	\$2.81	924	\$2.85	\$3.63	-4.45%	02/01/21 at 10:16:41.278482661	\$2.90	02/01/21 at 10:18:53.067307801	\$2.86
2/1/21	10:18:22.790255555	50	\$2.80	\$2.81	924	\$2.85	\$3.63	-4.45%	02/01/21 at 10:16:41.278482661	\$2.90	02/01/21 at 10:18:53.067307801	\$2.86
2/1/21	10:18:22.811409821	20	\$2.79	\$2.80	1,024	\$2.85	\$3.58	-4.45%	02/01/21 at 10:16:41.278482661	\$2.90	02/01/21 at 10:18:53.067307801	\$2.86
2/1/21	10:20:04.866435029	400	\$2.87	\$2.88	4,962	\$2.84	\$3.66	-3.81%	02/01/21 at 10:16:41.278482661	\$2.90	02/01/21 at 13:14:55.520849059	\$2.88
2/1/21	10:20:04.866667699	600	\$2.87	\$2.88	4,962	\$2.84	\$3.66	-3.81%	02/01/21 at 10:16:41.278482661	\$2.90	02/01/21 at 13:14:55.520849059	\$2.88
2/1/21	10:20:43.051873000	276	\$2.84	\$2.85	6,198	\$2.84	\$3.66	-4.15%	02/01/21 at 10:18:53.067307801	\$2.86	02/01/21 at 13:14:47.113965248	\$2.85
2/1/21	10:20:43.052508205	700	\$2.84	\$2.85	6,198	\$2.84	\$3.66	-4.15%	02/01/21 at 10:18:53.067307801	\$2.86	02/01/21 at 13:14:47.113965248	\$2.85
2/1/21	10:21:26.823357891	1,000	\$2.84	\$2.85	4,929	\$2.84	\$3.66	-5.54%	02/01/21 at 10:18:53.067307801	\$2.86	02/01/21 at 13:14:47.113965248	\$2.85
2/1/21	10:23:35.253975804	500	\$2.72	\$2.73	11,056	\$2.75	\$4.00	-6.69%	02/01/21 at 10:19:27.597307832	\$2.84	02/01/21 at 10:23:36.309432563	\$2.73
2/1/21	10:23:35.253975804	195	\$2.72	\$2.73	11,056	\$2.75	\$4.00	-6.69%	02/01/21 at 10:19:27.597307832	\$2.84	02/01/21 at 10:23:36.309432563	\$2.73
2/1/21	10:23:50.236881574	658	\$2.72	\$2.73	12,406	\$2.75	\$4.00	-6.66%	02/01/21 at 10:23:36.309432563	\$2.73	02/01/21 at 10:24:06.503587007	\$2.73
2/1/21	10:23:50.246123000	100	\$2.71	\$2.72	12,406	\$2.75	\$4.00	-6.66%	02/01/21 at 10:23:36.309432563	\$2.73	02/01/21 at 10:24:06.503587007	\$2.73
2/1/21	10:23:50.246123000	500	\$2.71	\$2.72	12,406	\$2.75	\$4.00	-6.66%	02/01/21 at 10:23:36.309432563	\$2.73	02/01/21 at 10:24:06.503587007	\$2.73
2/1/21	10:23:50.246123000	50	\$2.71	\$2.72	12,406	\$2.75	\$4.00	-6.66%	02/01/21 at 10:23:36.309432563	\$2.73	02/01/21 at 10:24:06.503587007	\$2.73
2/1/21	10:23:57.759949521	1,500	\$2.70	\$2.71	11,406	\$2.70	\$3.49	-6.38%	02/01/21 at 10:23:36.309432563	\$2.73	02/01/21 at 10:24:06.503587007	\$2.73
2/1/21	10:23:57.761673819	14	\$2.69	\$2.70	11,406	\$2.70	\$3.49	-6.38%	02/01/21 at 10:23:36.309432563	\$2.73	02/01/21 at 10:24:06.503587007	\$2.73
2/1/21	10:23:57.775797469	50	\$2.68	\$2.69	11,506	\$2.70	\$3.44	-6.38%	02/01/21 at 10:23:36.309432563	\$2.73	02/01/21 at 10:24:06.503587007	\$2.73
2/1/21	10:23:57.775797469	2	\$2.68	\$2.69	11,506	\$2.70	\$3.44	-6.38%	02/01/21 at 10:23:36.309432563	\$2.73	02/01/21 at 10:24:06.503587007	\$2.73
2/1/21	10:23:57.775797469	185	\$2.68	\$2.69	11,506	\$2.70	\$3.44	-6.38%	02/01/21 at 10:23:36.309432563	\$2.73	02/01/21 at 10:24:06.503587007	\$2.73



Date	Executing Purchase			Best Offer (NBBO Quote)	Baiting Orders			Price Decline <sup>1</sup>	Prior Sale by Defendant <sup>2</sup>		Next Sale by Defendant <sup>2</sup>	
	Time	Volume	Price <sup>3</sup>		Volume <sup>4</sup>	Min. Price <sup>5</sup>	Max. Price <sup>5</sup>		Time	Price	Time	Price
2/1/21	10:23:57.776943386	58	\$2.68	\$2.69	11,506	\$2.70	\$3.44	-6.38%	02/01/21 at 10:23:36.309432563	\$2.73	02/01/21 at 10:24:06.503587007	\$2.73
2/1/21	10:23:57.777278421	102	\$2.68	\$2.69	11,506	\$2.70	\$3.44	-6.38%	02/01/21 at 10:23:36.309432563	\$2.73	02/01/21 at 10:24:06.503587007	\$2.73
2/1/21	10:23:57.777795009	398	\$2.68	\$2.69	11,506	\$2.70	\$3.44	-6.38%	02/01/21 at 10:23:36.309432563	\$2.73	02/01/21 at 10:24:06.503587007	\$2.73
2/1/21	10:23:57.778231595	757	\$2.68	\$2.69	11,506	\$2.70	\$3.44	-6.38%	02/01/21 at 10:23:36.309432563	\$2.73	02/01/21 at 10:24:06.503587007	\$2.73
2/1/21	10:23:57.947865150	6	\$2.67	\$2.68	11,506	\$2.70	\$3.44	-6.38%	02/01/21 at 10:23:36.309432563	\$2.73	02/01/21 at 10:24:06.503587007	\$2.73
2/1/21	10:24:18.610796026	200	\$2.74	\$2.75	13,484	\$2.70	\$3.44	-7.09%	02/01/21 at 10:19:27.597307832	\$2.84	02/01/21 at 10:28:18.913732344	\$2.75
2/1/21	10:24:25.291411192	100	\$2.73	\$2.74	14,484	\$2.70	\$3.44	-7.09%	02/01/21 at 10:19:27.597307832	\$2.84	02/01/21 at 10:28:18.913732344	\$2.75
2/1/21	10:24:27.419037445	200	\$2.72	\$2.73	14,491	\$2.70	\$3.44	-7.09%	02/01/21 at 10:24:12.328986817	\$2.73	02/01/21 at 10:26:53.397548675	\$2.73
2/1/21	10:24:37.014361935	450	\$2.72	\$2.73	14,241	\$2.70	\$3.44	-6.34%	02/01/21 at 10:24:12.328986817	\$2.73	02/01/21 at 10:26:53.397548675	\$2.73
2/1/21	10:24:37.014366069	150	\$2.72	\$2.73	14,241	\$2.70	\$3.44	-6.34%	02/01/21 at 10:24:12.328986817	\$2.73	02/01/21 at 10:26:53.397548675	\$2.73
2/1/21	10:25:03.461217922	100	\$2.70	\$2.71	5,821	\$2.70	\$3.44	-5.76%	02/01/21 at 10:24:12.328986817	\$2.73	02/01/21 at 10:26:30.395516348	\$2.71
2/1/21	10:25:07.398330584	1,000	\$2.71	\$2.72	5,821	\$2.70	\$3.44	-5.76%	02/01/21 at 10:24:12.328986817	\$2.73	02/01/21 at 10:26:53.397548675	\$2.73
2/1/21	10:25:17.262339438	371	\$2.69	\$2.70	5,821	\$2.70	\$3.44	-5.36%	02/01/21 at 10:24:12.328986817	\$2.73	02/01/21 at 10:26:30.394961184	\$2.70
2/1/21	10:25:34.837134872	257	\$2.68	\$2.69	8,853	\$2.70	\$3.44	-4.73%	02/01/21 at 10:24:12.328986817	\$2.73	02/01/21 at 10:26:30.394961184	\$2.70
2/1/21	10:25:34.837494182	283	\$2.68	\$2.69	8,853	\$2.70	\$3.44	-4.73%	02/01/21 at 10:24:12.328986817	\$2.73	02/01/21 at 10:26:30.394961184	\$2.70
2/1/21	10:25:34.837588702	460	\$2.68	\$2.69	8,853	\$2.70	\$3.44	-4.73%	02/01/21 at 10:24:12.328986817	\$2.73	02/01/21 at 10:26:30.394961184	\$2.70
2/1/21	10:25:34.837588702	500	\$2.68	\$2.69	8,853	\$2.70	\$3.44	-4.73%	02/01/21 at 10:24:12.328986817	\$2.73	02/01/21 at 10:26:30.394961184	\$2.70
2/1/21	10:25:34.837588702	200	\$2.68	\$2.69	8,853	\$2.70	\$3.44	-4.73%	02/01/21 at 10:24:12.328986817	\$2.73	02/01/21 at 10:26:30.394961184	\$2.70
2/1/21	10:25:34.849625368	3	\$2.66	\$2.67	8,853	\$2.70	\$3.44	-4.73%	02/01/21 at 10:24:12.328986817	\$2.73	02/01/21 at 10:25:35.682781038	\$2.68



Date	Executing Purchase			Best Offer (NBBO Quote)	Baiting Orders			Price Decline <sup>1</sup>	Prior Sale by Defendant <sup>2</sup>		Next Sale by Defendant <sup>2</sup>	
	Time	Volume	Price <sup>3</sup>		Volume <sup>4</sup>	Min. Price <sup>5</sup>	Max. Price <sup>5</sup>		Time	Price	Time	Price
2/1/21	10:25:34.851975027	2	\$2.66	\$2.67	8,853	\$2.70	\$3.44	-4.73%	02/01/21 at 10:24:12.328986817	\$2.73	02/01/21 at 10:25:35.682781038	\$2.68
2/1/21	10:25:51.007188846	3	\$2.65	\$2.66	9,859	\$2.70	\$3.44	-4.73%	02/01/21 at 10:25:35.682781038	\$2.68	02/01/21 at 10:26:30.394961184	\$2.70
2/1/21	10:25:51.007431102	200	\$2.65	\$2.66	9,859	\$2.70	\$3.44	-4.73%	02/01/21 at 10:25:35.682781038	\$2.68	02/01/21 at 10:26:30.394961184	\$2.70
2/1/21	10:25:56.008118921	1,000	\$2.64	\$2.65	5,809	\$2.70	\$3.15	-4.73%	02/01/21 at 10:25:35.682781038	\$2.68	02/01/21 at 10:26:30.394961184	\$2.70
2/1/21	10:25:59.966276234	700	\$2.63	\$2.64	5,806	\$2.70	\$3.15	-4.73%	02/01/21 at 10:25:35.682781038	\$2.68	02/01/21 at 10:26:30.394961184	\$2.70
2/1/21	10:28:28.831510375	1,000	\$2.73	\$2.74	2,935	\$2.75	\$3.10	-3.64%	02/01/21 at 10:28:18.913732344	\$2.75	02/01/21 at 10:32:55.997039809	\$2.75
2/1/21	10:34:18.633409553	7,000	\$2.75	\$2.76	800	\$2.76	\$3.10	-3.60%	02/01/21 at 10:19:27.597307832	\$2.84	02/01/21 at 13:10:57.775201237	\$2.76
2/1/21	10:40:09.598682615	100	\$2.63	\$2.64	1,972	\$2.57	\$3.60	-5.20%	02/01/21 at 10:39:37.067266376	\$2.65	02/01/21 at 11:00:39.455898028	\$2.66
2/1/21	10:40:09.598682615	1	\$2.63	\$2.64	1,972	\$2.57	\$3.60	-5.20%	02/01/21 at 10:39:37.067266376	\$2.65	02/01/21 at 11:00:39.455898028	\$2.66
2/1/21	10:41:21.677556106	1,000	\$2.58	\$2.59	2,872	\$2.57	\$3.34	-4.14%	02/01/21 at 10:39:37.067266376	\$2.65	02/01/21 at 10:45:54.417339785	\$2.62
2/1/21	10:41:34.814564102	5	\$2.57	\$2.58	3,703	\$2.57	\$3.34	-3.77%	02/01/21 at 10:39:37.067266376	\$2.65	02/01/21 at 10:41:38.773371995	\$2.58
2/1/21	10:45:36.384868036	100	\$2.57	\$2.58	54	\$2.69	\$3.25	-3.03%	02/01/21 at 10:41:38.773371995	\$2.58	02/01/21 at 10:45:54.417339785	\$2.62
2/1/21	10:46:04.044977899	300	\$2.61	\$2.62	230	\$2.63	\$3.25	-2.66%	02/01/21 at 10:45:54.417339785	\$2.62	02/01/21 at 10:48:23.068735285	\$2.62
2/1/21	10:46:31.569637391	10	\$2.57	\$2.58	730	\$2.63	\$3.05	-2.66%	02/01/21 at 10:45:54.417339785	\$2.62	02/01/21 at 10:48:23.068735285	\$2.62
2/1/21	10:47:09.700877550	15	\$2.58	\$2.60	840	\$2.63	\$3.05	-2.66%	02/01/21 at 10:45:54.417339785	\$2.62	02/01/21 at 10:48:23.068735285	\$2.62
2/1/21	10:49:03.571562366	100	\$2.60	\$2.61	34,320	\$2.57	\$3.50	-4.17%	02/01/21 at 10:48:23.068754895	\$2.62	02/01/21 at 10:58:20.635685256	\$2.61
2/1/21	10:51:07.848753698	5	\$2.53	\$2.54	7,315	\$2.55	\$3.05	-3.83%	02/01/21 at 10:48:23.068754895	\$2.62	02/01/21 at 10:51:51.817069393	\$2.55
2/1/21	10:51:07.848820258	864	\$2.53	\$2.54	7,315	\$2.55	\$3.05	-3.83%	02/01/21 at 10:48:23.068754895	\$2.62	02/01/21 at 10:51:51.817069393	\$2.55
2/1/21	10:51:07.848886314	136	\$2.53	\$2.54	7,315	\$2.55	\$3.05	-3.83%	02/01/21 at 10:48:23.068754895	\$2.62	02/01/21 at 10:51:51.817069393	\$2.55

Date	Executing Purchase			Best Offer (NBBO Quote)	Baiting Orders			Price Decline <sup>1</sup>	Prior Sale by Defendant <sup>2</sup>		Next Sale by Defendant <sup>2</sup>	
	Time	Volume	Price <sup>3</sup>		Volume <sup>4</sup>	Min. Price <sup>5</sup>	Max. Price <sup>5</sup>		Time	Price	Time	Price
2/1/21	10:51:16.849908969	1	\$2.52	\$2.53	2,315	\$2.55	\$3.10	-3.83%	02/01/21 at 10:48:23.068754895	\$2.62	02/01/21 at 10:51:51.817069393	\$2.55
2/1/21	10:51:16.849908969	50	\$2.52	\$2.53	2,315	\$2.55	\$3.10	-3.83%	02/01/21 at 10:48:23.068754895	\$2.62	02/01/21 at 10:51:51.817069393	\$2.55
2/1/21	10:51:16.849908969	500	\$2.52	\$2.53	2,315	\$2.55	\$3.10	-3.83%	02/01/21 at 10:48:23.068754895	\$2.62	02/01/21 at 10:51:51.817069393	\$2.55
2/1/21	10:51:22.872057866	2,630	\$2.51	\$2.52	2,315	\$2.55	\$3.10	-3.83%	02/01/21 at 10:48:23.068754895	\$2.62	02/01/21 at 10:51:51.817069393	\$2.55
2/1/21	10:51:22.872136169	2,258	\$2.51	\$2.52	2,315	\$2.55	\$3.10	-3.83%	02/01/21 at 10:48:23.068754895	\$2.62	02/01/21 at 10:51:51.817069393	\$2.55
2/1/21	10:51:22.872517087	112	\$2.51	\$2.52	2,315	\$2.55	\$3.10	-3.83%	02/01/21 at 10:48:23.068754895	\$2.62	02/01/21 at 10:51:51.817069393	\$2.55
2/1/21	10:54:17.066704864	10	\$2.57	\$2.58	7,400	\$2.60	\$5.50	-3.08%	02/01/21 at 10:48:23.068754895	\$2.62	02/01/21 at 10:57:41.671852634	\$2.60
2/1/21	10:54:42.770224071	2	\$2.58	\$2.59	4,140	\$2.60	\$5.50	-3.09%	02/01/21 at 10:48:23.068754895	\$2.62	02/01/21 at 10:57:41.671852634	\$2.60
2/1/21	10:54:50.502138732	1,965	\$2.57	\$2.58	4,140	\$2.60	\$3.65	-3.09%	02/01/21 at 10:48:23.068754895	\$2.62	02/01/21 at 10:57:41.671852634	\$2.60
2/1/21	10:55:03.371466476	100	\$2.56	\$2.57	8,410	\$2.60	\$3.65	-3.09%	02/01/21 at 10:48:23.068754895	\$2.62	02/01/21 at 10:55:09.986561736	\$2.57
2/1/21	10:55:03.371466476	500	\$2.56	\$2.57	8,410	\$2.60	\$3.65	-3.09%	02/01/21 at 10:48:23.068754895	\$2.62	02/01/21 at 10:55:09.986561736	\$2.57
2/1/21	11:01:44.338652611	2,119	\$2.59	\$2.60	1,201	\$2.61	\$3.36	-4.12%	02/01/21 at 11:00:43.970606548	\$2.66	02/01/21 at 11:02:36.268314222	\$2.63
2/1/21	11:01:44.338790985	1,881	\$2.59	\$2.60	1,201	\$2.61	\$3.36	-4.12%	02/01/21 at 11:00:43.970606548	\$2.66	02/01/21 at 11:02:36.268314222	\$2.63
2/1/21	11:03:07.363260184	1,090	\$2.60	\$2.61	1,991	\$2.64	\$3.50	-3.03%	02/01/21 at 11:02:36.268314222	\$2.63	02/01/21 at 11:17:05.681220254	\$2.61
2/1/21	11:03:39.216149655	8,941	\$2.57	\$2.58	1,701	\$2.64	\$3.50	-3.03%	02/01/21 at 11:02:36.268314222	\$2.63	02/01/21 at 11:04:25.934997893	\$2.60
2/1/21	11:03:48.907922720	1,500	\$2.58	\$2.59	1,601	\$3.50	\$3.50	-3.03%	02/01/21 at 11:02:36.268314222	\$2.63	02/01/21 at 11:04:25.934997893	\$2.60
2/1/21	11:05:44.966718639	1	\$2.58	\$2.59	3,550	\$2.55	\$3.31	-7.60%	02/01/21 at 11:04:25.934997893	\$2.60	02/01/21 at 11:16:52.549113847	\$2.60
2/1/21	11:05:50.411686061	100	\$2.57	\$2.58	3,550	\$2.55	\$3.31	-7.60%	02/01/21 at 11:04:25.934997893	\$2.60	02/01/21 at 11:16:09.013222234	\$2.58
2/1/21	11:06:23.190214355	10	\$2.56	\$2.57	3,560	\$2.55	\$3.31	-7.60%	02/01/21 at 11:04:25.934997893	\$2.60	02/01/21 at 11:16:09.013222234	\$2.58

Date	Executing Purchase			Best Offer (NBBO Quote)	Baiting Orders			Price Decline <sup>1</sup>	Prior Sale by Defendant <sup>2</sup>		Next Sale by Defendant <sup>2</sup>	
	Time	Volume	Price <sup>3</sup>		Volume <sup>4</sup>	Min. Price <sup>5</sup>	Max. Price <sup>5</sup>		Time	Price	Time	Price
2/1/21	11:06:24.166642626	2	\$2.55	\$2.56	3,560	\$2.55	\$3.31	-7.60%	02/01/21 at 11:04:25.934997893	\$2.60	02/01/21 at 11:11:35.622184115	\$2.56
2/1/21	11:06:24.166642626	258	\$2.55	\$2.56	3,560	\$2.55	\$3.31	-7.60%	02/01/21 at 11:04:25.934997893	\$2.60	02/01/21 at 11:11:35.622184115	\$2.56
2/1/21	11:06:24.520013309	880	\$2.55	\$2.56	3,560	\$2.55	\$3.31	-7.60%	02/01/21 at 11:04:25.934997893	\$2.60	02/01/21 at 11:11:35.622184115	\$2.56
2/1/21	11:06:24.520056693	838	\$2.55	\$2.56	3,560	\$2.55	\$3.31	-7.60%	02/01/21 at 11:04:25.934997893	\$2.60	02/01/21 at 11:11:35.622184115	\$2.56
2/1/21	11:06:24.520136595	124	\$2.55	\$2.56	3,560	\$2.55	\$3.31	-7.60%	02/01/21 at 11:04:25.934997893	\$2.60	02/01/21 at 11:11:35.622184115	\$2.56
2/1/21	11:06:24.520136595	50	\$2.55	\$2.56	3,560	\$2.55	\$3.31	-7.60%	02/01/21 at 11:04:25.934997893	\$2.60	02/01/21 at 11:11:35.622184115	\$2.56
2/1/21	11:06:24.520136595	100	\$2.55	\$2.56	3,560	\$2.55	\$3.31	-7.60%	02/01/21 at 11:04:25.934997893	\$2.60	02/01/21 at 11:11:35.622184115	\$2.56
2/1/21	11:06:24.520136595	50	\$2.55	\$2.56	3,560	\$2.55	\$3.31	-7.60%	02/01/21 at 11:04:25.934997893	\$2.60	02/01/21 at 11:11:35.622184115	\$2.56
2/1/21	11:06:24.520136595	25	\$2.55	\$2.56	3,560	\$2.55	\$3.31	-7.60%	02/01/21 at 11:04:25.934997893	\$2.60	02/01/21 at 11:11:35.622184115	\$2.56
2/1/21	11:10:06.028764289	15	\$2.49	\$2.50	2,407	\$2.55	\$2.60	-2.80%	02/01/21 at 11:04:25.934997893	\$2.60	02/01/21 at 11:10:13.598545525	\$2.50
2/1/21	11:17:40.476652984	10	\$2.61	\$2.62	690	\$2.98	\$3.32	-4.12%	02/01/21 at 11:02:36.268314222	\$2.63	02/01/21 at 11:26:07.557530296	\$2.63
2/1/21	11:18:07.908917171	500	\$2.58	\$2.59	190	\$2.61	\$3.32	-4.12%	02/01/21 at 11:17:05.681220254	\$2.61	02/01/21 at 11:18:29.157410997	\$2.60
2/1/21	11:18:29.625078167	290	\$2.59	\$2.60	982	\$2.61	\$3.32	-4.12%	02/01/21 at 11:18:29.157410997	\$2.60	02/01/21 at 11:26:07.557530296	\$2.63
2/1/21	11:22:57.972847168	200	\$2.56	\$2.57	1,000	\$3.05	\$3.05	-2.32%	02/01/21 at 11:18:29.157410997	\$2.60	02/01/21 at 11:23:12.393484523	\$2.58
2/1/21	11:22:57.972847168	1	\$2.56	\$2.57	1,000	\$3.05	\$3.05	-2.32%	02/01/21 at 11:18:29.157410997	\$2.60	02/01/21 at 11:23:12.393484523	\$2.58
2/1/21	11:26:50.059860023	100	\$2.60	\$2.61	642	\$2.65	\$5.00	-3.41%	02/01/21 at 11:26:07.557530296	\$2.63	02/01/21 at 11:28:53.957159819	\$2.62
2/1/21	11:26:50.061132777	1	\$2.58	\$2.60	642	\$2.65	\$5.00	-3.41%	02/01/21 at 11:26:07.557530296	\$2.63	02/01/21 at 11:27:50.448285858	\$2.60
2/1/21	11:26:50.061195494	24	\$2.58	\$2.60	642	\$2.65	\$5.00	-3.41%	02/01/21 at 11:26:07.557530296	\$2.63	02/01/21 at 11:27:50.448285858	\$2.60
2/1/21	11:31:06.317520028	20	\$2.68	\$2.69	576	\$2.70	\$3.49	-3.34%	02/01/21 at 10:34:59.799745933	\$2.75	02/01/21 at 11:31:41.186403624	\$2.70

Date	Executing Purchase			Best Offer (NBBO Quote)	Baiting Orders			Price Decline <sup>1</sup>	Prior Sale by Defendant <sup>2</sup>		Next Sale by Defendant <sup>2</sup>	
	Time	Volume	Price <sup>3</sup>		Volume <sup>4</sup>	Min. Price <sup>5</sup>	Max. Price <sup>5</sup>		Time	Price	Time	Price
2/1/21	11:32:31.716205468	1,000	\$2.72	\$2.73	2,666	\$2.69	\$3.50	-4.36%	02/01/21 at 11:32:08.133484268	\$2.74	02/01/21 at 11:33:21.324816678	\$2.73
2/1/21	11:32:31.716205468	1	\$2.72	\$2.73	2,666	\$2.69	\$3.50	-4.36%	02/01/21 at 11:32:08.133484268	\$2.74	02/01/21 at 11:33:21.324816678	\$2.73
2/1/21	11:41:08.957673455	2,900	\$2.67	\$2.68	800	\$2.67	\$3.72	-3.70%	02/01/21 at 11:33:21.324816678	\$2.73	02/01/21 at 11:41:49.845043466	\$2.68
2/1/21	11:41:08.957687778	3,500	\$2.67	\$2.68	800	\$2.67	\$3.72	-3.70%	02/01/21 at 11:33:21.324816678	\$2.73	02/01/21 at 11:41:49.845043466	\$2.68
2/1/21	11:41:08.957696704	3,244	\$2.67	\$2.68	800	\$2.67	\$3.72	-3.70%	02/01/21 at 11:33:21.324816678	\$2.73	02/01/21 at 11:41:49.845043466	\$2.68
2/1/21	11:41:08.957764004	353	\$2.67	\$2.68	800	\$2.67	\$3.72	-3.70%	02/01/21 at 11:33:21.324816678	\$2.73	02/01/21 at 11:41:49.845043466	\$2.68
2/1/21	11:46:39.860836734	100	\$2.73	\$2.74	1,957	\$2.77	\$3.36	-6.18%	02/01/21 at 11:45:34.964833854	\$2.74	02/01/21 at 13:10:52.011118290	\$2.75
2/1/21	11:51:59.522937438	900	\$2.65	\$2.66	5,200	\$2.71	\$3.90	-1.87%	02/01/21 at 11:45:34.964833854	\$2.74	02/01/21 at 11:52:00.690594734	\$2.66
2/1/21	11:55:24.847204470	100	\$2.69	\$2.71	3,810	\$2.71	\$3.45	-2.93%	02/01/21 at 11:52:25.014777105	\$2.71	02/01/21 at 12:11:43.288150764	\$2.71
2/1/21	11:56:35.922537644	310	\$2.70	\$2.71	2,120	\$2.71	\$3.45	-4.03%	02/01/21 at 11:52:25.014777105	\$2.71	02/01/21 at 12:11:43.288150764	\$2.71
2/1/21	11:56:35.922565039	690	\$2.70	\$2.71	2,120	\$2.71	\$3.45	-4.03%	02/01/21 at 11:52:25.014777105	\$2.71	02/01/21 at 12:11:43.288150764	\$2.71
2/1/21	11:56:35.922565039	1	\$2.70	\$2.71	2,120	\$2.71	\$3.45	-4.03%	02/01/21 at 11:52:25.014777105	\$2.71	02/01/21 at 12:11:43.288150764	\$2.71
2/1/21	11:59:27.405126542	497	\$2.64	\$2.65	557	\$2.78	\$100.00	-2.63%	02/01/21 at 11:58:49.333421052	\$2.67	02/01/21 at 12:02:38.304077818	\$2.66
2/1/21	12:16:18.230869749	25	\$2.68	\$2.69	159	\$2.77	\$3.00	-2.59%	02/01/21 at 12:12:06.261305787	\$2.72	02/01/21 at 13:01:56.044542815	\$2.69
2/1/21	12:16:18.231279454	1	\$2.68	\$2.69	159	\$2.77	\$3.00	-2.59%	02/01/21 at 12:12:06.261305787	\$2.72	02/01/21 at 13:01:56.044542815	\$2.69
2/1/21	12:16:27.085496571	200	\$2.66	\$2.67	159	\$2.77	\$3.00	-2.59%	02/01/21 at 12:12:06.261305787	\$2.72	02/01/21 at 12:21:00.042050438	\$2.67
2/1/21	12:16:27.085496571	1	\$2.66	\$2.67	159	\$2.77	\$3.00	-2.59%	02/01/21 at 12:12:06.261305787	\$2.72	02/01/21 at 12:21:00.042050438	\$2.67
2/1/21	12:16:35.453715177	30	\$2.64	\$2.65	159	\$2.77	\$3.00	-2.96%	02/01/21 at 12:12:06.261305787	\$2.72	02/01/21 at 12:20:38.539600745	\$2.66
2/1/21	12:16:35.453715177	1	\$2.64	\$2.65	159	\$2.77	\$3.00	-2.96%	02/01/21 at 12:12:06.261305787	\$2.72	02/01/21 at 12:20:38.539600745	\$2.66

Date	Executing Purchase			Best Offer (NBBO Quote)	Baiting Orders			Price Decline <sup>1</sup>	Prior Sale by Defendant <sup>2</sup>		Next Sale by Defendant <sup>2</sup>	
	Time	Volume	Price <sup>3</sup>		Volume <sup>4</sup>	Min. Price <sup>5</sup>	Max. Price <sup>5</sup>		Time	Price	Time	Price
2/1/21	12:16:35.453715177	3	\$2.64	\$2.65	159	\$2.77	\$3.00	-2.96%	02/01/21 at 12:12:06.261305787	\$2.72	02/01/21 at 12:20:38.539600745	\$2.66
2/1/21	12:20:55.804819415	100	\$2.66	\$2.67	700	\$2.66	\$3.98	-2.62%	02/01/21 at 12:12:06.261305787	\$2.72	02/01/21 at 12:21:00.042050438	\$2.67
2/1/21	12:21:10.897447017	190	\$2.65	\$2.66	1,947	\$2.66	\$3.98	-3.73%	02/01/21 at 12:21:00.042050438	\$2.67	02/01/21 at 12:58:27.889939025	\$2.66
2/1/21	12:38:04.836400083	300	\$2.58	\$2.59	1,016	\$2.58	\$4.00	-1.54%	02/01/21 at 12:30:21.061448211	\$2.63	02/01/21 at 12:45:20.781717174	\$2.59
2/1/21	13:19:09.555454723	1,000	\$2.87	\$2.88	4,540	\$2.83	\$4.10	-3.46%	02/01/21 at 13:14:55.520849059	\$2.88	02/10/21 at 15:58:01.214282570	\$3.03
2/1/21	13:19:49.118850801	6	\$2.86	\$2.87	4,961	\$2.83	\$3.66	-4.15%	02/01/21 at 13:14:55.520849059	\$2.88	02/10/21 at 15:58:01.214282570	\$3.03
2/1/21	13:23:13.517635172	400	\$2.80	\$2.81	5,739	\$2.77	\$3.54	-2.83%	02/01/21 at 13:18:48.426536395	\$2.83	02/01/21 at 13:25:07.586946496	\$2.82
2/1/21	13:23:13.518288289	100	\$2.80	\$2.81	5,739	\$2.77	\$3.54	-2.83%	02/01/21 at 13:18:48.426536395	\$2.83	02/01/21 at 13:25:07.586946496	\$2.82
2/1/21	13:34:45.403495522	400	\$2.82	\$2.83	6,312	\$2.83	\$3.20	-1.75%	02/01/21 at 13:34:36.447707187	\$2.84	02/10/21 at 15:58:01.214282570	\$3.03
2/1/21	13:35:44.533170675	1,201	\$2.84	\$2.85	3,512	\$2.83	\$3.53	-3.51%	02/01/21 at 13:15:22.707572389	\$2.86	02/10/21 at 15:58:01.214282570	\$3.03
2/1/21	13:35:53.380659196	399	\$2.84	\$2.85	15,620	\$2.83	\$3.53	-3.51%	02/01/21 at 13:15:22.707572389	\$2.86	02/10/21 at 15:58:01.214282570	\$3.03
2/1/21	13:37:08.935545237	3	\$2.78	\$2.79	2,100	\$3.53	\$3.78	-3.51%	02/01/21 at 13:34:36.447707187	\$2.84	02/01/21 at 13:38:36.249212542	\$2.79
2/1/21	13:37:09.064043109	700	\$2.77	\$2.78	2,100	\$3.53	\$3.78	-3.51%	02/01/21 at 13:34:36.447707187	\$2.84	02/01/21 at 13:38:36.249212542	\$2.79
2/1/21	13:43:41.818312554	20	\$2.75	\$2.76	17,478	\$2.74	\$3.53	-4.26%	02/01/21 at 13:38:36.249212542	\$2.79	02/01/21 at 13:43:56.926584363	\$2.78
2/1/21	13:43:41.818312554	2	\$2.75	\$2.76	17,478	\$2.74	\$3.53	-4.26%	02/01/21 at 13:38:36.249212542	\$2.79	02/01/21 at 13:43:56.926584363	\$2.78
2/1/21	13:44:47.453860740	3,850	\$2.77	\$2.78	2,147	\$2.74	\$3.53	-3.23%	02/01/21 at 13:43:56.926584363	\$2.78	02/01/21 at 13:53:27.983908772	\$2.82
2/1/21	13:44:47.453863405	640	\$2.77	\$2.78	2,147	\$2.74	\$3.53	-3.23%	02/01/21 at 13:43:56.926584363	\$2.78	02/01/21 at 13:53:27.983908772	\$2.82
2/1/21	13:44:47.453882085	38	\$2.77	\$2.78	2,147	\$2.74	\$3.53	-3.23%	02/01/21 at 13:43:56.926584363	\$2.78	02/01/21 at 13:53:27.983908772	\$2.82
2/1/21	13:44:47.453889900	1,000	\$2.77	\$2.78	2,147	\$2.74	\$3.53	-3.23%	02/01/21 at 13:43:56.926584363	\$2.78	02/01/21 at 13:53:27.983908772	\$2.82

Date	Executing Purchase			Best Offer (NBBO Quote)	Baiting Orders			Price Decline <sup>1</sup>	Prior Sale by Defendant <sup>2</sup>		Next Sale by Defendant <sup>2</sup>	
	Time	Volume	Price <sup>3</sup>		Volume <sup>4</sup>	Min. Price <sup>5</sup>	Max. Price <sup>5</sup>		Time	Price	Time	Price
2/1/21	13:44:47.454244885	7,648	\$2.77	\$2.78	2,147	\$2.74	\$3.53	-3.23%	02/01/21 at 13:43:56.926584363	\$2.78	02/01/21 at 13:53:27.983908772	\$2.82
2/1/21	13:44:47.454253921	6,898	\$2.77	\$2.78	2,147	\$2.74	\$3.53	-3.23%	02/01/21 at 13:43:56.926584363	\$2.78	02/01/21 at 13:53:27.983908772	\$2.82
2/1/21	13:54:12.077194892	50	\$2.80	\$2.81	9,862	\$2.83	\$2.89	-2.11%	02/01/21 at 13:53:27.983908772	\$2.82	02/01/21 at 13:54:53.714148633	\$2.81
2/1/21	13:54:12.077194892	1,750	\$2.80	\$2.81	9,862	\$2.83	\$2.89	-2.11%	02/01/21 at 13:53:27.983908772	\$2.82	02/01/21 at 13:54:53.714148633	\$2.81
2/1/21	13:54:12.077199696	650	\$2.80	\$2.81	9,862	\$2.83	\$2.89	-2.11%	02/01/21 at 13:53:27.983908772	\$2.82	02/01/21 at 13:54:53.714148633	\$2.81
2/1/21	13:54:12.077261860	1,846	\$2.80	\$2.81	9,862	\$2.83	\$2.89	-2.11%	02/01/21 at 13:53:27.983908772	\$2.82	02/01/21 at 13:54:53.714148633	\$2.81
2/1/21	13:54:12.077410092	100	\$2.80	\$2.81	9,862	\$2.83	\$2.89	-2.11%	02/01/21 at 13:53:27.983908772	\$2.82	02/01/21 at 13:54:53.714148633	\$2.81
2/1/21	13:54:12.077415621	100	\$2.80	\$2.81	9,862	\$2.83	\$2.89	-2.11%	02/01/21 at 13:53:27.983908772	\$2.82	02/01/21 at 13:54:53.714148633	\$2.81
2/1/21	13:54:12.077498784	554	\$2.80	\$2.81	9,862	\$2.83	\$2.89	-2.11%	02/01/21 at 13:53:27.983908772	\$2.82	02/01/21 at 13:54:53.714148633	\$2.81
2/1/21	14:03:12.029179158	40	\$2.75	\$2.76	4,180	\$2.84	\$6.00	-1.44%	02/01/21 at 14:02:34.436992270	\$2.76	02/01/21 at 14:04:26.247000148	\$2.76
2/1/21	14:03:12.035175113	515	\$2.74	\$2.75	4,180	\$2.84	\$6.00	-1.44%	02/01/21 at 14:02:34.436992270	\$2.76	02/01/21 at 14:04:26.247000148	\$2.76
2/1/21	14:03:12.035179941	485	\$2.74	\$2.75	4,180	\$2.84	\$6.00	-1.44%	02/01/21 at 14:02:34.436992270	\$2.76	02/01/21 at 14:04:26.247000148	\$2.76
2/1/21	14:06:42.691033009	100	\$2.79	\$2.80	100	\$2.88	\$4.00	-2.48%	02/01/21 at 14:06:09.371939943	\$2.80	02/10/21 at 15:58:01.214282570	\$3.03
2/1/21	14:07:42.740694203	500	\$2.78	\$2.79	200	\$2.93	\$4.00	-3.55%	02/01/21 at 14:06:09.371939943	\$2.80	02/10/21 at 15:58:01.214282570	\$3.03
2/1/21	14:09:29.813559177	931	\$2.73	\$2.74	100	\$3.53	\$5.00	-3.21%	02/01/21 at 14:06:09.371939943	\$2.80	02/01/21 at 14:51:59.827230875	\$2.75
2/1/21	14:09:29.813599381	69	\$2.73	\$2.74	100	\$3.53	\$5.00	-3.21%	02/01/21 at 14:06:09.371939943	\$2.80	02/01/21 at 14:51:59.827230875	\$2.75
2/1/21	14:10:15.689523696	190	\$2.72	\$2.73	1,100	\$3.53	\$5.00	-2.87%	02/01/21 at 14:06:09.371939943	\$2.80	02/01/21 at 14:15:26.206041229	\$2.73
2/1/21	14:10:15.689526732	10	\$2.72	\$2.73	1,100	\$3.53	\$5.00	-2.87%	02/01/21 at 14:06:09.371939943	\$2.80	02/01/21 at 14:15:26.206041229	\$2.73
2/1/21	14:33:14.850440634	500	\$2.66	\$2.67	160	\$2.65	\$5.00	-3.32%	02/01/21 at 14:30:20.302749288	\$2.73	02/01/21 at 14:46:41.662998354	\$2.68

Date	Executing Purchase			Best Offer (NBBO Quote)	Baiting Orders			Price Decline <sup>1</sup>	Prior Sale by Defendant <sup>2</sup>		Next Sale by Defendant <sup>2</sup>	
	Time	Volume	Price <sup>3</sup>		Volume <sup>4</sup>	Min. Price <sup>5</sup>	Max. Price <sup>5</sup>		Time	Price	Time	Price
2/1/21	14:33:37.088882500	23	\$2.66	\$2.67	60	\$2.65	\$5.00	-2.96%	02/01/21 at 14:30:20.302749288	\$2.73	02/01/21 at 14:46:41.662998354	\$2.68
2/1/21	14:34:01.192468058	900	\$2.64	\$2.65	160	\$2.65	\$5.00	-2.60%	02/01/21 at 14:30:20.302749288	\$2.73	02/01/21 at 14:34:26.898626640	\$2.65
2/1/21	14:34:04.139989788	330	\$2.64	\$2.65	660	\$2.65	\$5.00	-2.60%	02/01/21 at 14:30:20.302749288	\$2.73	02/01/21 at 14:34:26.898626640	\$2.65
2/1/21	14:34:04.140223152	770	\$2.64	\$2.65	660	\$2.65	\$5.00	-2.60%	02/01/21 at 14:30:20.302749288	\$2.73	02/01/21 at 14:34:26.898626640	\$2.65
2/1/21	14:37:45.384919430	1,000	\$2.66	\$2.67	6,555	\$2.65	\$6.00	-4.01%	02/01/21 at 14:30:20.302749288	\$2.73	02/01/21 at 14:46:41.662998354	\$2.68
2/1/21	14:37:45.429239791	3,000	\$2.63	\$2.64	6,555	\$2.65	\$6.00	-4.01%	02/01/21 at 14:34:26.898626640	\$2.65	02/01/21 at 14:41:21.127248016	\$2.65
2/1/21	15:06:28.771294487	320	\$2.71	\$2.72	1,100	\$2.76	\$3.44	-3.64%	02/01/21 at 14:56:43.439910793	\$2.74	02/08/21 at 15:51:53.597971688	\$2.76
2/1/21	15:06:28.771294487	8,000	\$2.71	\$2.72	1,100	\$2.76	\$3.44	-3.64%	02/01/21 at 14:56:43.439910793	\$2.74	02/08/21 at 15:51:53.597971688	\$2.76
2/1/21	15:06:28.785610964	45	\$2.70	\$2.71	1,100	\$2.76	\$3.44	-3.64%	02/01/21 at 15:02:09.224701590	\$2.71	02/08/21 at 15:51:53.597971688	\$2.76
2/1/21	15:06:39.365857145	67	\$2.66	\$2.67	1,100	\$2.76	\$3.44	-2.93%	02/01/21 at 15:02:09.224701590	\$2.71	02/01/21 at 15:08:20.383002745	\$2.67
2/1/21	15:06:39.365857145	1	\$2.66	\$2.67	1,100	\$2.76	\$3.44	-2.93%	02/01/21 at 15:02:09.224701590	\$2.71	02/01/21 at 15:08:20.383002745	\$2.67
2/1/21	15:13:33.257621445	11	\$2.65	\$2.66	600	\$2.65	\$2.65	-1.50%	02/01/21 at 15:08:20.383002745	\$2.67	02/01/21 at 15:51:17.528615182	\$2.67
2/1/21	15:15:17.908398650	139	\$2.62	\$2.63	1,901	\$2.62	\$3.39	-3.01%	02/01/21 at 15:10:29.660339244	\$2.65	02/01/21 at 15:49:54.696881033	\$2.65
2/1/21	15:15:17.908398650	561	\$2.62	\$2.63	1,901	\$2.62	\$3.39	-3.01%	02/01/21 at 15:10:29.660339244	\$2.65	02/01/21 at 15:49:54.696881033	\$2.65
2/1/21	15:19:36.142182495	100	\$2.60	\$2.61	1,700	\$3.00	\$3.85	-1.92%	02/01/21 at 15:10:29.660339244	\$2.65	02/01/21 at 15:31:36.885385439	\$2.61
2/1/21	15:19:36.142182495	1,000	\$2.60	\$2.61	1,700	\$3.00	\$3.85	-1.92%	02/01/21 at 15:10:29.660339244	\$2.65	02/01/21 at 15:31:36.885385439	\$2.61
2/1/21	15:35:33.594001798	100	\$2.60	\$2.61	1,000	\$2.66	\$2.66	-1.34%	02/01/21 at 15:35:30.185362603	\$2.61	02/01/21 at 15:45:24.088345112	\$2.61
2/1/21	15:49:05.646334528	500	\$2.61	\$2.62	605	\$2.65	\$2.65	-2.09%	02/01/21 at 15:32:18.650791104	\$2.62	02/01/21 at 15:49:54.696881033	\$2.65
2/1/21	15:54:48.548250664	100	\$2.68	\$2.69	2,700	\$2.85	\$3.46	-2.76%	02/01/21 at 15:54:06.527105556	\$2.70	02/08/21 at 15:51:53.597971688	\$2.76



Date	Executing Purchase			Best Offer (NBBO Quote)	Baiting Orders			Price Decline <sup>1</sup>	Prior Sale by Defendant <sup>2</sup>		Next Sale by Defendant <sup>2</sup>	
	Time	Volume	Price <sup>3</sup>		Volume <sup>4</sup>	Min. Price <sup>5</sup>	Max. Price <sup>5</sup>		Time	Price	Time	Price
2/1/21	15:55:27.965204105	100	\$2.67	\$2.68	31,700	\$2.85	\$3.34	-2.21%	02/01/21 at 15:54:06.527105556	\$2.70	02/08/21 at 15:51:53.597971688	\$2.76
2/1/21	15:56:08.281845172	6	\$2.70	\$2.71	36,600	\$2.81	\$3.75	-2.21%	02/01/21 at 15:02:09.224701590	\$2.71	02/08/21 at 15:51:53.597971688	\$2.76
2/2/21	09:34:41.097336745	420	\$2.28	\$2.29	100	\$2.94	\$2.94	-4.24%	02/01/21 at 15:59:57.930458325	\$2.67	02/02/21 at 11:50:08.873802133	\$2.29
2/2/21	09:50:49.872205795	4,017	\$2.15	\$2.16	4,116	\$2.17	\$2.76	-3.21%	02/02/21 at 09:50:47.207596565	\$2.16	02/02/21 at 09:57:26.066865012	\$2.20
2/2/21	10:16:06.192940525	1	\$2.21	\$2.22	6,650	\$2.32	\$2.42	-3.59%	02/02/21 at 10:12:45.642694344	\$2.24	02/02/21 at 11:06:11.747204517	\$2.22
2/2/21	10:16:06.192940525	1,000	\$2.21	\$2.22	6,650	\$2.32	\$2.42	-3.59%	02/02/21 at 10:12:45.642694344	\$2.24	02/02/21 at 11:06:11.747204517	\$2.22
2/2/21	10:16:06.192940525	10	\$2.21	\$2.22	6,650	\$2.32	\$2.42	-3.59%	02/02/21 at 10:12:45.642694344	\$2.24	02/02/21 at 11:06:11.747204517	\$2.22
2/2/21	10:16:06.262930083	5	\$2.20	\$2.21	6,650	\$2.32	\$2.42	-3.59%	02/02/21 at 10:12:45.642694344	\$2.24	02/02/21 at 11:00:27.714719734	\$2.21
2/2/21	10:16:06.262930083	250	\$2.20	\$2.21	6,650	\$2.32	\$2.42	-3.59%	02/02/21 at 10:12:45.642694344	\$2.24	02/02/21 at 11:00:27.714719734	\$2.21
2/2/21	10:16:06.262930083	6,819	\$2.20	\$2.21	6,650	\$2.32	\$2.42	-3.59%	02/02/21 at 10:12:45.642694344	\$2.24	02/02/21 at 11:00:27.714719734	\$2.21
2/2/21	10:16:06.262963894	2,181	\$2.20	\$2.21	6,650	\$2.32	\$2.42	-3.59%	02/02/21 at 10:12:45.642694344	\$2.24	02/02/21 at 11:00:27.714719734	\$2.21
2/2/21	10:23:32.002118378	37	\$2.16	\$2.17	2,541	\$2.17	\$2.26	-3.18%	02/02/21 at 10:21:45.485545651	\$2.19	02/02/21 at 10:43:47.375035689	\$2.18
2/2/21	10:23:32.002159349	662	\$2.16	\$2.17	2,541	\$2.17	\$2.26	-3.18%	02/02/21 at 10:21:45.485545651	\$2.19	02/02/21 at 10:43:47.375035689	\$2.18
2/2/21	10:23:32.002672616	251	\$2.16	\$2.17	2,541	\$2.17	\$2.26	-3.18%	02/02/21 at 10:21:45.485545651	\$2.19	02/02/21 at 10:43:47.375035689	\$2.18
2/2/21	10:23:32.002672616	50	\$2.16	\$2.17	2,541	\$2.17	\$2.26	-3.18%	02/02/21 at 10:21:45.485545651	\$2.19	02/02/21 at 10:43:47.375035689	\$2.18
2/2/21	10:23:32.002672616	60	\$2.16	\$2.17	2,541	\$2.17	\$2.26	-3.18%	02/02/21 at 10:21:45.485545651	\$2.19	02/02/21 at 10:43:47.375035689	\$2.18
2/2/21	10:25:00.517444811	1	\$2.15	\$2.16	81	\$2.14	\$2.19	-2.75%	02/02/21 at 10:21:45.485545651	\$2.19	02/02/21 at 10:43:47.375035689	\$2.18
2/2/21	10:36:27.206125724	8	\$2.12	\$2.13	33	\$2.13	\$2.25	-1.41%	02/02/21 at 10:29:14.945870434	\$2.13	02/02/21 at 10:42:21.081024561	\$2.14
2/2/21	10:36:31.930880219	8,309	\$2.11	\$2.12	33	\$2.13	\$2.25	-1.41%	02/02/21 at 10:36:06.768839333	\$2.12	02/02/21 at 10:41:06.806588927	\$2.12



Date	Executing Purchase			Best Offer (NBBO Quote)	Baiting Orders			Price Decline <sup>1</sup>	Prior Sale by Defendant <sup>2</sup>		Next Sale by Defendant <sup>2</sup>	
	Time	Volume	Price <sup>3</sup>		Volume <sup>4</sup>	Min. Price <sup>5</sup>	Max. Price <sup>5</sup>		Time	Price	Time	Price
2/2/21	10:36:31.931130148	476	\$2.11	\$2.12	33	\$2.13	\$2.25	-1.41%	02/02/21 at 10:36:06.768839333	\$2.12	02/02/21 at 10:41:06.806588927	\$2.12
2/2/21	12:34:09.695370256	10,000	\$2.24	\$2.25	7	\$2.85	\$2.90	-2.65%	02/02/21 at 12:10:19.779055968	\$2.32	02/02/21 at 13:11:49.715900500	\$2.27
2/2/21	12:35:30.591659002	50	\$2.20	\$2.21	100	\$2.85	\$2.85	-2.65%	02/02/21 at 12:10:19.779055968	\$2.32	02/02/21 at 12:35:32.836541232	\$2.22
2/2/21	15:25:11.800908498	200	\$2.50	\$2.51	50	\$2.50	\$3.13	-2.79%	02/01/21 at 15:59:57.930458325	\$2.67	02/02/21 at 15:44:13.179492675	\$2.52
2/2/21	15:27:49.141523407	2,000	\$2.46	\$2.47	150	\$2.62	\$3.18	-2.40%	02/02/21 at 15:25:06.065757958	\$2.50	02/02/21 at 15:30:03.450402407	\$2.47
2/2/21	15:44:30.554875177	1,057	\$2.50	\$2.51	7	\$2.85	\$2.85	-2.76%	02/02/21 at 15:44:13.179533171	\$2.52	02/02/21 at 16:00:00.783281602	\$2.51
2/2/21	15:44:30.555103175	3,110	\$2.50	\$2.51	7	\$2.85	\$2.85	-2.76%	02/02/21 at 15:44:13.179533171	\$2.52	02/02/21 at 16:00:00.783281602	\$2.51
2/2/21	15:44:30.555198514	200	\$2.50	\$2.51	7	\$2.85	\$2.85	-2.76%	02/02/21 at 15:44:13.179533171	\$2.52	02/02/21 at 16:00:00.783281602	\$2.51
2/2/21	15:44:30.555206402	100	\$2.50	\$2.51	7	\$2.85	\$2.85	-2.76%	02/02/21 at 15:44:13.179533171	\$2.52	02/02/21 at 16:00:00.783281602	\$2.51
2/2/21	15:44:30.555338652	533	\$2.50	\$2.51	7	\$2.85	\$2.85	-2.76%	02/02/21 at 15:44:13.179533171	\$2.52	02/02/21 at 16:00:00.783281602	\$2.51
2/3/21	15:57:25.687114693	600	\$2.36	\$2.37	340	\$2.36	\$3.06	-2.50%	02/03/21 at 09:42:52.232224263	\$2.41	02/08/21 at 15:51:53.597971688	\$2.76
2/12/21	09:30:01.523536751	251	\$2.64	\$2.65	381	\$2.97	\$3.36	-3.01%	02/11/21 at 09:39:07.152941736	\$3.20	02/17/21 at 15:58:48.778379797	\$2.86
2/12/21	09:30:01.524556111	9	\$2.64	\$2.65	381	\$2.97	\$3.36	-3.01%	02/11/21 at 09:39:07.152941736	\$3.20	02/17/21 at 15:58:48.778379797	\$2.86
2/12/21	09:30:01.525673011	240	\$2.64	\$2.65	381	\$2.97	\$3.36	-3.01%	02/11/21 at 09:39:07.152941736	\$3.20	02/17/21 at 15:58:48.778379797	\$2.86
2/12/21	09:30:01.897430515	100	\$2.62	\$2.63	381	\$2.97	\$3.36	-3.01%	02/11/21 at 09:39:07.152941736	\$3.20	02/12/21 at 09:30:01.897473092	\$2.63
2/12/21	09:30:30.710489688	322	\$2.60	\$2.62	1,600	\$2.97	\$3.36	-3.01%	02/12/21 at 09:30:01.897473092	\$2.63	02/17/21 at 15:58:48.778379797	\$2.86
2/12/21	09:30:32.006992024	300	\$2.60	\$2.62	1,600	\$2.97	\$3.36	-3.01%	02/12/21 at 09:30:01.897473092	\$2.63	02/17/21 at 15:58:48.778379797	\$2.86
2/12/21	09:30:37.553537062	178	\$2.60	\$2.61	1,600	\$2.97	\$3.36	-3.01%	02/12/21 at 09:30:01.897473092	\$2.63	02/17/21 at 15:58:48.778379797	\$2.86
2/12/21	09:30:37.553537062	500	\$2.60	\$2.61	1,600	\$2.97	\$3.36	-3.01%	02/12/21 at 09:30:01.897473092	\$2.63	02/17/21 at 15:58:48.778379797	\$2.86

Date	Executing Purchase			Best Offer (NBBO Quote)	Baiting Orders			Price Decline <sup>1</sup>	Prior Sale by Defendant <sup>2</sup>		Next Sale by Defendant <sup>2</sup>	
	Time	Volume	Price <sup>3</sup>		Volume <sup>4</sup>	Min. Price <sup>5</sup>	Max. Price <sup>5</sup>		Time	Price	Time	Price
2/12/21	09:30:37.553600035	4,075	\$2.60	\$2.61	1,600	\$2.97	\$3.36	-3.01%	02/12/21 at 09:30:01.897473092	\$2.63	02/17/21 at 15:58:48.778379797	\$2.86
2/12/21	09:30:37.553601098	300	\$2.60	\$2.61	1,600	\$2.97	\$3.36	-3.01%	02/12/21 at 09:30:01.897473092	\$2.63	02/17/21 at 15:58:48.778379797	\$2.86
2/12/21	09:30:37.553609850	600	\$2.60	\$2.61	1,600	\$2.97	\$3.36	-3.01%	02/12/21 at 09:30:01.897473092	\$2.63	02/17/21 at 15:58:48.778379797	\$2.86
2/12/21	09:30:37.553612012	300	\$2.60	\$2.61	1,600	\$2.97	\$3.36	-3.01%	02/12/21 at 09:30:01.897473092	\$2.63	02/17/21 at 15:58:48.778379797	\$2.86
2/12/21	09:30:37.553618798	300	\$2.60	\$2.61	1,600	\$2.97	\$3.36	-3.01%	02/12/21 at 09:30:01.897473092	\$2.63	02/17/21 at 15:58:48.778379797	\$2.86
2/12/21	09:30:37.553623903	280	\$2.60	\$2.61	1,600	\$2.97	\$3.36	-3.01%	02/12/21 at 09:30:01.897473092	\$2.63	02/17/21 at 15:58:48.778379797	\$2.86
2/12/21	09:30:37.554058609	15	\$2.59	\$2.60	1,600	\$2.97	\$3.36	-3.01%	02/12/21 at 09:30:01.897473092	\$2.63	02/17/21 at 15:58:48.778379797	\$2.86
2/16/21	09:31:30.108599540	239	\$2.80	\$2.81	100	\$3.60	\$3.60	-2.82%	02/11/21 at 09:39:07.152941736	\$3.20	02/17/21 at 15:58:48.778379797	\$2.86
2/16/21	09:31:34.353522314	1,000	\$2.78	\$2.79	100	\$3.60	\$3.60	-2.82%	02/11/21 at 09:39:07.152941736	\$3.20	02/17/21 at 15:58:48.778379797	\$2.86
2/17/21	09:30:02.387431237	200	\$2.89	\$2.90	400	\$3.50	\$3.71	-4.14%	02/11/21 at 09:39:07.152941736	\$3.20	10/22/21 at 09:30:02.893210664	\$7.60
2/17/21	09:30:07.927232684	20	\$2.85	\$2.89	200	\$3.66	\$3.71	-4.14%	02/11/21 at 09:39:07.152941736	\$3.20	02/17/21 at 15:58:48.778379797	\$2.86
2/17/21	09:31:16.553859827	4	\$2.82	\$2.85	100	\$3.66	\$3.66	-4.14%	02/11/21 at 09:39:07.152941736	\$3.20	02/17/21 at 15:58:48.778379797	\$2.86
2/17/21	09:36:17.801485300	1	\$2.75	\$2.76	100	\$3.52	\$3.54	-4.26%	02/11/21 at 09:39:07.152941736	\$3.20	02/17/21 at 15:58:48.778379797	\$2.86
2/25/21	09:30:02.046770053	6	\$2.10	\$2.13	100	\$2.70	\$2.70	-3.63%	02/22/21 at 15:59:21.572585276	\$2.30	03/11/21 at 09:30:01.441774671	\$2.18
2/25/21	09:30:02.046770053	20	\$2.10	\$2.13	100	\$2.70	\$2.70	-3.63%	02/22/21 at 15:59:21.572585276	\$2.30	03/11/21 at 09:30:01.441774671	\$2.18
2/25/21	09:30:02.046770053	5	\$2.10	\$2.13	100	\$2.70	\$2.70	-3.63%	02/22/21 at 15:59:21.572585276	\$2.30	03/11/21 at 09:30:01.441774671	\$2.18
2/25/21	09:30:08.079038104	50	\$2.08	\$2.09	100	\$2.70	\$2.70	-3.63%	02/22/21 at 15:59:21.572585276	\$2.30	03/11/21 at 09:30:01.441774671	\$2.18
2/25/21	09:30:08.079038104	44	\$2.08	\$2.09	100	\$2.70	\$2.70	-3.63%	02/22/21 at 15:59:21.572585276	\$2.30	03/11/21 at 09:30:01.441774671	\$2.18
3/1/21	15:53:02.671327195	800	\$1.81	\$1.82	100	\$1.80	\$1.80	-1.65%	02/24/21 at 09:30:02.216209684	\$2.02	03/11/21 at 09:30:01.441774671	\$2.18

Date	Executing Purchase			Best Offer (NBBO Quote)	Baiting Orders			Price Decline <sup>1</sup>	Prior Sale by Defendant <sup>2</sup>		Next Sale by Defendant <sup>2</sup>	
	Time	Volume	Price <sup>3</sup>		Volume <sup>4</sup>	Min. Price <sup>5</sup>	Max. Price <sup>5</sup>		Time	Price	Time	Price
3/1/21	15:53:02.671327195	1,000	\$1.81	\$1.82	100	\$1.80	\$1.80	-1.65%	02/24/21 at 09:30:02.216209684	\$2.02	03/11/21 at 09:30:01.441774671	\$2.18
3/10/21	09:30:10.020324381	565	\$1.70	\$1.71	18,147	\$1.73	\$498.00	-2.31%	03/10/21 at 09:30:01.195892190	\$1.72	03/11/21 at 09:30:01.441774671	\$2.18
3/10/21	09:30:10.022947512	1,669	\$1.70	\$1.71	18,147	\$1.73	\$498.00	-2.31%	03/10/21 at 09:30:01.195892190	\$1.72	03/11/21 at 09:30:01.441774671	\$2.18
3/10/21	09:30:10.022963313	1,331	\$1.70	\$1.71	18,147	\$1.73	\$498.00	-2.31%	03/10/21 at 09:30:01.195892190	\$1.72	03/11/21 at 09:30:01.441774671	\$2.18
3/11/21	15:55:08.873673199	200	\$1.89	\$1.90	227	\$1.96	\$3.31	-2.09%	03/11/21 at 09:30:57.333883927	\$2.26	03/12/21 at 16:00:00.779099497	\$2.10
3/11/21	15:55:08.873673199	175	\$1.89	\$1.90	227	\$1.96	\$3.31	-2.09%	03/11/21 at 09:30:57.333883927	\$2.26	03/12/21 at 16:00:00.779099497	\$2.10
3/11/21	15:55:27.177885618	49	\$1.90	\$1.91	100	\$1.96	\$3.31	-2.09%	03/11/21 at 09:30:57.333883927	\$2.26	03/12/21 at 16:00:00.779099497	\$2.10
3/19/21	09:30:02.922551458	6	\$2.14	\$2.15	100	\$2.48	\$2.48	-1.39%	03/18/21 at 09:33:30.876248799	\$2.24	04/06/21 at 09:30:26.718581355	\$2.15
3/24/21	09:31:17.568193237	30	\$2.00	\$2.01	278,140	\$2.09	\$498.00	-4.39%	03/23/21 at 09:30:01.675948559	\$2.06	04/06/21 at 09:30:26.718581355	\$2.15
3/24/21	09:31:17.568193237	10,500	\$2.00	\$2.01	278,140	\$2.09	\$498.00	-4.39%	03/23/21 at 09:30:01.675948559	\$2.06	04/06/21 at 09:30:26.718581355	\$2.15
3/24/21	15:50:38.955448571	910	\$1.94	\$1.95	100	\$2.41	\$2.41	-3.08%	03/23/21 at 09:30:01.675948559	\$2.06	04/06/21 at 09:30:26.718581355	\$2.15
3/26/21	09:30:01.332413963	58	\$1.79	\$1.80	1,336	\$1.81	\$3.50	-5.00%	03/25/21 at 16:00:01.227267770	\$1.90	04/06/21 at 09:30:26.718581355	\$2.15
3/26/21	09:30:01.333522749	224	\$1.79	\$1.80	1,336	\$1.81	\$3.50	-5.00%	03/25/21 at 16:00:01.227267770	\$1.90	04/06/21 at 09:30:26.718581355	\$2.15
3/26/21	09:30:01.333574041	735	\$1.79	\$1.80	1,336	\$1.81	\$3.50	-5.00%	03/25/21 at 16:00:01.227267770	\$1.90	04/06/21 at 09:30:26.718581355	\$2.15
3/26/21	09:30:01.333943110	224	\$1.79	\$1.80	1,336	\$1.81	\$3.50	-5.00%	03/25/21 at 16:00:01.227267770	\$1.90	04/06/21 at 09:30:26.718581355	\$2.15
3/26/21	09:30:01.334001224	300	\$1.79	\$1.80	1,336	\$1.81	\$3.50	-5.00%	03/25/21 at 16:00:01.227267770	\$1.90	04/06/21 at 09:30:26.718581355	\$2.15
3/26/21	09:30:01.334852258	176	\$1.79	\$1.80	1,336	\$1.81	\$3.50	-5.00%	03/25/21 at 16:00:01.227267770	\$1.90	04/06/21 at 09:30:26.718581355	\$2.15
3/26/21	09:30:01.764826219	13,800	\$1.79	\$1.80	4,440	\$1.81	\$3.50	-5.00%	03/25/21 at 16:00:01.227267770	\$1.90	04/06/21 at 09:30:26.718581355	\$2.15
3/26/21	09:30:01.764850475	6,778	\$1.79	\$1.80	4,440	\$1.81	\$3.50	-5.00%	03/25/21 at 16:00:01.227267770	\$1.90	04/06/21 at 09:30:26.718581355	\$2.15

Date	Executing Purchase			Best Offer (NBBO Quote)	Baiting Orders			Price Decline <sup>1</sup>	Prior Sale by Defendant <sup>2</sup>		Next Sale by Defendant <sup>2</sup>	
	Time	Volume	Price <sup>3</sup>		Volume <sup>4</sup>	Min. Price <sup>5</sup>	Max. Price <sup>5</sup>		Time	Price	Time	Price
3/26/21	09:30:31.788219912	100	\$1.75	\$1.76	4,933	\$1.81	\$3.50	-5.00%	03/25/21 at 16:00:01.227267770	\$1.90	04/06/21 at 09:30:26.718581355	\$2.15
4/6/21	09:30:02.297318544	100	\$2.13	\$2.14	13,892	\$2.19	\$498.00	-2.78%	03/18/21 at 09:33:30.876248799	\$2.24	04/06/21 at 09:30:26.718581355	\$2.15
4/6/21	09:30:02.297318544	500	\$2.13	\$2.14	13,892	\$2.19	\$498.00	-2.78%	03/18/21 at 09:33:30.876248799	\$2.24	04/06/21 at 09:30:26.718581355	\$2.15
4/6/21	09:30:12.256650473	15	\$2.12	\$2.13	42,603	\$2.19	\$498.00	-2.78%	03/18/21 at 09:33:30.876248799	\$2.24	04/06/21 at 09:30:26.718581355	\$2.15
4/6/21	09:30:12.256650473	750	\$2.12	\$2.13	42,603	\$2.19	\$498.00	-2.78%	03/18/21 at 09:33:30.876248799	\$2.24	04/06/21 at 09:30:26.718581355	\$2.15
4/14/21	09:30:06.255748493	1,000	\$1.78	\$1.79	5,258	\$1.84	\$600.00	-2.75%	04/09/21 at 09:34:43.699527433	\$1.90	10/22/21 at 09:30:02.893210664	\$7.60
4/16/21	09:30:00.375664573	652	\$1.53	\$1.55	140	\$1.55	\$3.42	-4.52%	04/09/21 at 09:34:43.699527433	\$1.90	04/26/21 at 15:59:44.213175369	\$1.62
4/16/21	09:30:00.380195422	390	\$1.52	\$1.54	140	\$1.55	\$3.42	-4.52%	04/09/21 at 09:34:43.699527433	\$1.90	04/26/21 at 15:59:44.213175369	\$1.62
4/16/21	09:30:00.468317382	4,610	\$1.52	\$1.54	140	\$1.55	\$3.42	-4.52%	04/09/21 at 09:34:43.699527433	\$1.90	04/26/21 at 15:59:44.213175369	\$1.62
4/23/21	09:30:55.623137982	600	\$1.52	\$1.53	100	\$1.97	\$1.97	-1.95%	04/09/21 at 09:34:43.699527433	\$1.90	04/26/21 at 15:59:44.213175369	\$1.62
4/27/21	09:30:04.937488415	50	\$1.64	\$1.66	10,428	\$1.70	\$498.00	-3.57%	04/09/21 at 09:34:43.699527433	\$1.90	04/28/21 at 15:59:56.280427125	\$1.65
4/27/21	09:30:35.551829031	100	\$1.63	\$1.64	404,486	\$1.70	\$498.00	-3.57%	04/09/21 at 09:34:43.699527433	\$1.90	04/28/21 at 15:59:56.280427125	\$1.65
4/27/21	09:30:35.551829031	100	\$1.63	\$1.64	404,486	\$1.70	\$498.00	-3.57%	04/09/21 at 09:34:43.699527433	\$1.90	04/28/21 at 15:59:56.280427125	\$1.65
5/4/21	09:30:25.695983602	313	\$1.50	\$1.51	100	\$1.93	\$1.93	-2.63%	04/28/21 at 15:59:56.280427125	\$1.65	05/11/21 at 09:33:50.421196342	\$1.53
5/4/21	09:30:25.695995538	237	\$1.50	\$1.51	100	\$1.93	\$1.93	-2.63%	04/28/21 at 15:59:56.280427125	\$1.65	05/11/21 at 09:33:50.421196342	\$1.53
5/11/21	15:53:09.859745494	100	\$1.38	\$1.39	3,819	\$1.39	\$1.50	-1.43%	05/11/21 at 09:33:50.421196342	\$1.53	06/01/21 at 15:59:57.919932407	\$1.41
5/17/21	09:31:53.209751797	3,000	\$1.23	\$1.25	248,066	\$1.33	\$107.00	-6.92%	05/12/21 at 15:59:44.213258533	\$1.37	05/20/21 at 15:59:57.963732149	\$1.30
5/28/21	09:31:46.195123698	1	\$1.32	\$1.33	100	\$1.71	\$1.71	-2.24%	05/28/21 at 09:30:01.057702071	\$1.33	06/01/21 at 15:59:57.919932407	\$1.41
8/17/21	09:33:11.907958583	1,160	\$0.862	\$0.8725	100	\$1.14	\$1.14	-3.63%	08/12/21 at 15:55:26.169548781	\$1.09	08/23/21 at 15:53:15.747704673	\$0.91

Date	Executing Purchase			Best Offer (NBBO Quote)	Baiting Orders			Price Decline <sup>1</sup>	Prior Sale by Defendant <sup>2</sup>		Next Sale by Defendant <sup>2</sup>	
	Time	Volume	Price <sup>3</sup>		Volume <sup>4</sup>	Min. Price <sup>5</sup>	Max. Price <sup>5</sup>		Time	Price	Time	Price
10/21/21	15:55:46.648148394	1,000	\$1.62	\$1.63	45,451	\$1.63	\$12.00	-5.79%	10/21/21 at 15:55:32.455732843	\$1.63	10/21/21 at 15:56:26.155115002	\$1.64
10/21/21	15:56:26.753123774	250	\$1.63	\$1.64	56,284	\$1.63	\$2.11	-4.57%	10/21/21 at 15:56:26.155115002	\$1.64	10/21/21 at 15:57:20.329231732	\$1.64
10/21/21	15:56:58.387657407	200	\$1.62	\$1.63	117,746	\$1.62	\$2.11	-4.88%	10/21/21 at 15:56:47.968313998	\$1.63	10/21/21 at 15:57:20.329231732	\$1.64
10/22/21	09:30:00.191429919	100	\$7.51	\$7.52	14,184	\$7.95	\$15.00	-7.81%			10/22/21 at 09:30:02.893210664	\$7.60
10/22/21	09:30:00.191448862	26	\$7.51	\$7.52	14,184	\$7.95	\$15.00	-7.81%			10/22/21 at 09:30:02.893210664	\$7.60
10/22/21	09:30:00.239173676	150	\$7.50	\$7.52	19,584	\$7.95	\$15.00	-7.81%			10/22/21 at 09:30:02.893210664	\$7.60
10/22/21	09:30:00.239173676	50	\$7.50	\$7.52	19,584	\$7.95	\$15.00	-7.81%			10/22/21 at 09:30:02.893210664	\$7.60
10/22/21	09:30:00.239173676	10	\$7.50	\$7.52	19,584	\$7.95	\$15.00	-7.81%			10/22/21 at 09:30:02.893210664	\$7.60
10/22/21	09:30:00.729147433	50	\$7.50	\$7.53	21,194	\$7.95	\$15.00	-7.81%			10/22/21 at 09:30:02.893210664	\$7.60
10/22/21	09:30:00.729147433	148	\$7.50	\$7.53	21,194	\$7.95	\$15.00	-7.81%			10/22/21 at 09:30:02.893210664	\$7.60
10/22/21	09:30:00.729147433	10	\$7.50	\$7.53	21,194	\$7.95	\$15.00	-7.81%			10/22/21 at 09:30:02.893210664	\$7.60
10/22/21	09:47:45.819401895	20	\$16.00	\$16.14	27,965	\$16.46	\$500.00	-14.76%	10/22/21 at 09:47:45.364745862	\$16.50	10/22/21 at 09:47:48.354182741	\$16.01
10/22/21	09:47:45.819401895	10	\$16.00	\$16.14	27,965	\$16.46	\$500.00	-14.76%	10/22/21 at 09:47:45.364745862	\$16.50	10/22/21 at 09:47:48.354182741	\$16.01
10/22/21	09:47:45.819401895	10	\$16.00	\$16.14	27,965	\$16.46	\$500.00	-14.76%	10/22/21 at 09:47:45.364745862	\$16.50	10/22/21 at 09:47:48.354182741	\$16.01
10/22/21	09:47:45.899976848	100	\$15.84	\$15.86	27,975	\$16.46	\$500.00	-14.76%	10/22/21 at 09:47:45.364745862	\$16.50	10/22/21 at 09:47:46.459096068	\$15.94
10/22/21	09:47:46.208060046	100	\$16.00	\$16.14	27,995	\$16.46	\$500.00	-14.76%	10/22/21 at 09:47:45.364745862	\$16.50	10/22/21 at 09:47:48.354182741	\$16.01
10/22/21	09:47:46.500168737	10	\$15.95	\$16.00	28,005	\$16.46	\$500.00	-14.76%	10/22/21 at 09:47:45.364745862	\$16.50	10/22/21 at 09:47:48.347569346	\$16.00
10/22/21	09:47:47.229402679	10	\$15.49	\$15.50	28,178	\$16.46	\$500.00	-14.76%	10/22/21 at 09:47:46.822265081	\$15.95	10/22/21 at 09:47:48.061981987	\$15.86
10/22/21	09:47:47.255114569	3	\$15.40	\$15.53	28,178	\$16.46	\$500.00	-14.76%	10/22/21 at 09:47:46.822265081	\$15.95	10/22/21 at 09:47:48.061981987	\$15.86

Date	Executing Purchase			Best Offer (NBBO Quote)	Baiting Orders			Price Decline <sup>1</sup>	Prior Sale by Defendant <sup>2</sup>		Next Sale by Defendant <sup>2</sup>	
	Time	Volume	Price <sup>3</sup>		Volume <sup>4</sup>	Min. Price <sup>5</sup>	Max. Price <sup>5</sup>		Time	Price	Time	Price
10/22/21	09:47:50.496925427	100	\$16.53	\$16.69	28,493	\$17.00	\$500.00	- 15.98%			10/22/21 at 09:47:51.086436935	\$16.64
10/22/21	09:47:50.504685232	100	\$16.59	\$16.65	28,493	\$17.00	\$500.00	- 15.98%			10/22/21 at 09:47:51.086436935	\$16.64
10/22/21	09:47:50.748200332	100	\$16.34	\$16.39	28,493	\$17.00	\$500.00	- 15.98%	10/22/21 at 09:47:49.400073642	\$16.50	10/22/21 at 09:47:51.086436935	\$16.64
10/22/21	09:47:51.824979860	100	\$16.59	\$16.77	27,948	\$17.00	\$500.00	- 16.28%	10/22/21 at 09:47:51.442612066	\$16.75	10/22/21 at 09:47:52.271527875	\$16.78
10/22/21	09:47:51.973908681	500	\$16.59	\$16.79	27,948	\$17.00	\$500.00	- 16.28%	10/22/21 at 09:47:51.442612066	\$16.75	10/22/21 at 09:47:52.271527875	\$16.78
10/22/21	09:47:51.985358755	30	\$16.55	\$16.79	27,948	\$17.00	\$500.00	- 16.28%	10/22/21 at 09:47:51.442612066	\$16.75	10/22/21 at 09:47:52.271527875	\$16.78
10/22/21	09:47:52.001746605	1	\$16.39	\$16.67	27,948	\$17.00	\$500.00	- 16.28%	10/22/21 at 09:47:51.442612066	\$16.75	10/22/21 at 09:47:52.271527875	\$16.78
10/22/21	09:47:52.002981620	60	\$16.38	\$16.67	27,948	\$17.00	\$500.00	- 16.28%	10/22/21 at 09:47:51.442612066	\$16.75	10/22/21 at 09:47:52.271527875	\$16.78
10/22/21	09:47:52.005425174	1,000	\$16.36	\$16.67	27,948	\$17.00	\$500.00	- 16.28%	10/22/21 at 09:47:51.442612066	\$16.75	10/22/21 at 09:47:52.271527875	\$16.78
10/22/21	09:47:52.038489683	500	\$16.24	\$16.44	27,948	\$17.00	\$500.00	- 16.28%	10/22/21 at 09:47:51.442612066	\$16.75	10/22/21 at 09:47:52.271527875	\$16.78
10/22/21	09:47:52.661932420	25	\$16.68	\$16.96	28,058	\$17.00	\$500.00	- 17.26%	10/22/21 at 09:47:52.271527875	\$16.78	10/22/21 at 09:47:52.785553416	\$16.85
10/22/21	09:47:52.892789293	5	\$16.84	\$16.98	28,063	\$17.00	\$500.00	- 18.46%	10/22/21 at 09:47:52.785553416	\$16.85	10/22/21 at 09:47:52.916924892	\$16.99
10/22/21	09:47:53.852635994	210	\$16.85	\$16.95	28,013	\$17.00	\$500.00	- 18.46%	10/22/21 at 09:47:53.076045363	\$16.99	10/22/21 at 09:53:38.331214866	\$20.02
10/22/21	09:47:53.896138676	10	\$16.85	\$16.98	28,013	\$17.00	\$500.00	- 18.46%	10/22/21 at 09:47:53.076045363	\$16.99	10/22/21 at 09:53:38.331214866	\$20.02
10/22/21	09:47:53.914233144	30	\$16.85	\$16.96	28,013	\$17.00	\$500.00	- 18.46%	10/22/21 at 09:47:53.076045363	\$16.99	10/22/21 at 09:53:38.331214866	\$20.02
10/22/21	09:54:01.777970969	50	\$24.00	\$24.01	62,086	\$18.00	\$2,500.00	- 23.56%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:01.777970969	15	\$24.00	\$24.01	62,086	\$18.00	\$2,500.00	- 23.56%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:01.800751694	100	\$24.00	\$24.01	62,086	\$18.00	\$2,500.00	- 23.56%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:01.800751694	5	\$24.00	\$24.01	62,086	\$18.00	\$2,500.00	- 23.56%			10/22/21 at 09:54:10.639511368	\$24.01

Date	Executing Purchase			Best Offer (NBBO Quote)	Baiting Orders			Price Decline <sup>1</sup>	Prior Sale by Defendant <sup>2</sup>		Next Sale by Defendant <sup>2</sup>	
	Time	Volume	Price <sup>3</sup>		Volume <sup>4</sup>	Min. Price <sup>5</sup>	Max. Price <sup>5</sup>		Time	Price	Time	Price
10/22/21	09:54:01.800751694	2	\$24.00	\$24.01	62,086	\$18.00	\$2,500.00	- 23.56%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:01.800751694	200	\$24.00	\$24.01	62,086	\$18.00	\$2,500.00	- 23.56%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:02.606265236	10	\$24.00	\$24.01	62,086	\$18.00	\$2,500.00	- 23.56%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:02.639108109	37	\$24.00	\$24.01	62,086	\$18.00	\$2,500.00	- 23.56%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:02.651977896	3	\$24.00	\$24.01	62,086	\$18.00	\$2,500.00	- 23.56%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:02.670591120	50	\$24.00	\$24.01	62,086	\$18.00	\$2,500.00	- 23.56%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:02.685482368	410	\$24.00	\$24.01	62,086	\$18.00	\$2,500.00	- 23.56%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:02.692737101	20	\$24.00	\$24.01	62,086	\$18.00	\$2,500.00	- 23.56%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:02.724554446	10	\$24.00	\$24.01	62,086	\$18.00	\$2,500.00	- 23.56%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:02.724554446	100	\$24.00	\$24.01	62,086	\$18.00	\$2,500.00	- 23.56%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:02.724554446	10	\$24.00	\$24.01	62,086	\$18.00	\$2,500.00	- 23.56%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:02.724554446	9	\$24.00	\$24.01	62,086	\$18.00	\$2,500.00	- 23.56%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:02.724554446	1	\$24.00	\$24.01	62,086	\$18.00	\$2,500.00	- 23.56%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:02.786072714	8	\$24.00	\$24.01	62,086	\$18.00	\$2,500.00	- 23.56%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:02.789628520	32	\$24.00	\$24.01	62,086	\$18.00	\$2,500.00	- 23.56%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:02.789628520	150	\$24.00	\$24.01	62,086	\$18.00	\$2,500.00	- 23.56%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:03.100411874	22	\$24.00	\$24.01	61,386	\$18.00	\$2,500.00	- 23.56%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:03.100411874	4	\$24.00	\$24.01	61,386	\$18.00	\$2,500.00	- 23.56%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:03.168317002	20	\$24.00	\$24.01	61,286	\$18.00	\$2,500.00	- 23.56%			10/22/21 at 09:54:10.639511368	\$24.01



Date	Executing Purchase			Best Offer (NBBO Quote)	Baiting Orders			Price Decline <sup>1</sup>	Prior Sale by Defendant <sup>2</sup>		Next Sale by Defendant <sup>2</sup>	
	Time	Volume	Price <sup>3</sup>		Volume <sup>4</sup>	Min. Price <sup>5</sup>	Max. Price <sup>5</sup>		Time	Price	Time	Price
10/22/21	09:54:03.172895857	15	\$24.00	\$24.01	61,286	\$18.00	\$2,500.00	- 23.56%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:03.196823548	85	\$24.00	\$24.01	61,286	\$18.00	\$2,500.00	- 23.56%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:03.196823548	39	\$24.00	\$24.01	61,286	\$18.00	\$2,500.00	- 23.56%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:03.254683518	5	\$24.00	\$24.01	61,286	\$18.00	\$2,500.00	- 23.56%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:03.254683518	10	\$24.00	\$24.01	61,286	\$18.00	\$2,500.00	- 23.56%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:03.254683518	1,000	\$24.00	\$24.01	61,286	\$18.00	\$2,500.00	- 23.56%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:03.254683518	200	\$24.00	\$24.01	61,286	\$18.00	\$2,500.00	- 23.56%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:03.355233372	25	\$23.99	\$24.00	61,386	\$18.00	\$2,500.00	- 23.56%	10/22/21 at 09:53:56.582633732	\$24.00	10/22/21 at 09:54:03.416784644	\$24.00
10/22/21	09:54:03.356421918	300	\$23.98	\$24.00	61,386	\$18.00	\$2,500.00	- 23.56%	10/22/21 at 09:53:56.582633732	\$24.00	10/22/21 at 09:54:03.416784644	\$24.00
10/22/21	09:54:03.358007743	20	\$23.96	\$23.98	61,386	\$18.00	\$2,500.00	- 23.56%	10/22/21 at 09:53:56.582633732	\$24.00	10/22/21 at 09:54:03.416784644	\$24.00
10/22/21	09:54:03.798711992	5	\$23.89	\$23.96	61,432	\$18.00	\$2,500.00	- 23.56%	10/22/21 at 09:54:03.416784644	\$24.00	10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:03.840908435	10	\$23.87	\$23.95	61,432	\$18.00	\$2,500.00	- 23.56%	10/22/21 at 09:54:03.416784644	\$24.00	10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:03.846234093	15	\$23.80	\$23.89	61,432	\$18.00	\$2,500.00	- 23.56%	10/22/21 at 09:54:03.416784644	\$24.00	10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:03.859421607	100	\$23.77	\$23.89	61,432	\$18.00	\$2,500.00	- 23.56%	10/22/21 at 09:54:03.416784644	\$24.00	10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:03.861701510	5	\$23.75	\$23.84	61,432	\$18.00	\$2,500.00	- 23.56%	10/22/21 at 09:54:03.416784644	\$24.00	10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:04.610482842	71	\$24.00	\$24.01	61,433	\$18.00	\$2,500.00	- 23.58%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:04.610785927	50	\$24.00	\$24.01	61,433	\$18.00	\$2,500.00	- 23.58%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:04.610785927	22	\$24.00	\$24.01	61,433	\$18.00	\$2,500.00	- 23.58%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:04.611776961	78	\$24.00	\$24.01	61,433	\$18.00	\$2,500.00	- 23.58%			10/22/21 at 09:54:10.639511368	\$24.01



Date	Executing Purchase			Best Offer (NBBO Quote)	Baiting Orders			Price Decline <sup>1</sup>	Prior Sale by Defendant <sup>2</sup>		Next Sale by Defendant <sup>2</sup>	
	Time	Volume	Price <sup>3</sup>		Volume <sup>4</sup>	Min. Price <sup>5</sup>	Max. Price <sup>5</sup>		Time	Price	Time	Price
10/22/21	09:54:04.663445184	500	\$24.00	\$24.01	61,433	\$18.00	\$2,500.00	- 23.58%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:04.668323657	5	\$24.00	\$24.01	61,433	\$18.00	\$2,500.00	- 23.58%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:05.122351794	400	\$24.00	\$24.01	61,938	\$18.00	\$2,500.00	- 23.58%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:05.122351794	50	\$24.00	\$24.01	61,938	\$18.00	\$2,500.00	- 23.58%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:05.122351794	2	\$24.00	\$24.01	61,938	\$18.00	\$2,500.00	- 23.58%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:05.131211142	20	\$24.00	\$24.01	61,938	\$18.00	\$2,500.00	- 23.58%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:05.138101687	20	\$24.00	\$24.01	61,938	\$18.00	\$2,500.00	- 23.58%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:05.239199645	28	\$24.00	\$24.01	63,138	\$18.00	\$2,500.00	- 23.58%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:05.239199645	20	\$24.00	\$24.01	63,138	\$18.00	\$2,500.00	- 23.58%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:05.239199645	32	\$24.00	\$24.01	63,138	\$18.00	\$2,500.00	- 23.58%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:05.239211951	71	\$24.00	\$24.01	63,138	\$18.00	\$2,500.00	- 23.58%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:05.466532615	50	\$24.00	\$24.01	64,737	\$18.00	\$2,500.00	- 23.58%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:05.546851674	45	\$24.00	\$24.01	64,737	\$18.00	\$2,500.00	- 23.58%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:06.306977511	35	\$24.00	\$24.01	64,487	\$18.00	\$2,500.00	- 23.58%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:06.306977511	600	\$24.00	\$24.01	64,487	\$18.00	\$2,500.00	- 23.58%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:06.306977511	10	\$24.00	\$24.01	64,487	\$18.00	\$2,500.00	- 23.58%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:06.306977511	50	\$24.00	\$24.01	64,487	\$18.00	\$2,500.00	- 23.58%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:06.306977511	267	\$24.00	\$24.01	64,487	\$18.00	\$2,500.00	- 23.58%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:06.341686886	733	\$24.00	\$24.01	64,487	\$18.00	\$2,500.00	- 23.58%			10/22/21 at 09:54:10.639511368	\$24.01

Date	Executing Purchase			Best Offer (NBBO Quote)	Baiting Orders			Price Decline <sup>1</sup>	Prior Sale by Defendant <sup>2</sup>		Next Sale by Defendant <sup>2</sup>	
	Time	Volume	Price <sup>3</sup>		Volume <sup>4</sup>	Min. Price <sup>5</sup>	Max. Price <sup>5</sup>		Time	Price	Time	Price
10/22/21	09:54:06.341686886	2	\$24.00	\$24.01	64,487	\$18.00	\$2,500.00	- 23.58%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:06.607588319	45	\$24.00	\$24.01	64,377	\$18.00	\$2,500.00	- 23.58%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:07.782584579	120	\$24.00	\$24.01	64,377	\$18.00	\$2,500.00	- 23.58%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:07.973699506	200	\$24.00	\$24.01	65,377	\$18.00	\$2,500.00	- 23.58%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:07.973699506	50	\$24.00	\$24.01	65,377	\$18.00	\$2,500.00	- 23.58%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:09.916093352	3	\$24.00	\$24.01	64,757	\$18.00	\$2,500.00	- 23.58%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:09.994556846	5	\$24.00	\$24.01	64,757	\$18.00	\$2,500.00	- 23.58%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:10.217083518	5	\$24.00	\$24.01	64,757	\$18.00	\$2,500.00	- 23.58%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:10.236142214	4	\$24.00	\$24.01	64,757	\$18.00	\$2,500.00	- 23.58%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:10.534164012	100	\$24.00	\$24.01	64,757	\$18.00	\$2,500.00	- 23.58%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:10.534164012	100	\$24.00	\$24.01	64,757	\$18.00	\$2,500.00	- 23.58%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:10.534164012	100	\$24.00	\$24.01	64,757	\$18.00	\$2,500.00	- 23.58%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:10.534164012	125	\$24.00	\$24.01	64,757	\$18.00	\$2,500.00	- 23.58%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:10.534164012	300	\$24.00	\$24.01	64,757	\$18.00	\$2,500.00	- 23.58%			10/22/21 at 09:54:10.639511368	\$24.01
10/22/21	09:54:10.647555953	600	\$23.97	\$23.99	64,757	\$18.00	\$2,500.00	- 23.69%	10/22/21 at 09:54:10.639514943	\$24.01		
10/22/21	09:54:10.661666775	100	\$23.73	\$23.86	64,757	\$18.00	\$2,500.00	- 23.69%	10/22/21 at 09:54:10.639514943	\$24.01		
10/22/21	09:54:10.665476981	100	\$23.41	\$23.71	64,757	\$18.00	\$2,500.00	- 23.69%	10/22/21 at 09:54:10.639514943	\$24.01		
10/22/21	09:54:10.981443867	2	\$23.04	\$23.30	64,857	\$18.00	\$2,500.00	- 23.69%	10/22/21 at 09:54:10.639514943	\$24.01		
10/22/21	09:54:11.038013796	5	\$23.00	\$23.11	65,025	\$18.00	\$2,500.00	- 23.69%	10/22/21 at 09:54:10.639514943	\$24.01		

Date	Executing Purchase			Best Offer (NBBO Quote)	Baiting Orders			Price Decline <sup>1</sup>	Prior Sale by Defendant <sup>2</sup>		Next Sale by Defendant <sup>2</sup>	
	Time	Volume	Price <sup>3</sup>		Volume <sup>4</sup>	Min. Price <sup>5</sup>	Max. Price <sup>5</sup>		Time	Price	Time	Price
10/22/21	09:54:11.038033409	30	\$23.00	\$23.11	65,025	\$18.00	\$2,500.00	- 23.69%	10/22/21 at 09:54:10.639514943	\$24.01		
10/22/21	09:54:11.038247371	164	\$23.00	\$23.11	65,025	\$18.00	\$2,500.00	- 23.69%	10/22/21 at 09:54:10.639514943	\$24.01		
10/22/21	09:54:11.040193562	93	\$23.00	\$23.11	65,025	\$18.00	\$2,500.00	- 23.69%	10/22/21 at 09:54:10.639514943	\$24.01		
10/22/21	09:54:11.150799392	100	\$23.00	\$23.05	65,045	\$18.00	\$2,500.00	- 23.69%	10/22/21 at 09:54:10.639514943	\$24.01		
10/22/21	09:54:11.152978153	238	\$23.00	\$23.05	65,045	\$18.00	\$2,500.00	- 23.69%	10/22/21 at 09:54:10.639514943	\$24.01		
10/22/21	09:54:11.155174850	65	\$23.00	\$23.05	65,045	\$18.00	\$2,500.00	- 23.69%	10/22/21 at 09:54:10.639514943	\$24.01		
10/22/21	09:54:11.156700724	197	\$23.00	\$23.05	65,045	\$18.00	\$2,500.00	- 23.69%	10/22/21 at 09:54:10.639514943	\$24.01		
10/22/21	09:54:11.243797443	20	\$23.00	\$23.18	64,945	\$18.00	\$2,500.00	- 23.69%	10/22/21 at 09:54:10.639514943	\$24.01		
10/22/21	09:54:11.243797443	10	\$23.00	\$23.18	64,945	\$18.00	\$2,500.00	- 23.69%	10/22/21 at 09:54:10.639514943	\$24.01		
10/22/21	09:54:11.259756644	20	\$23.00	\$23.18	64,945	\$18.00	\$2,500.00	- 23.69%	10/22/21 at 09:54:10.639514943	\$24.01		
10/22/21	09:54:11.259756644	150	\$23.00	\$23.18	64,945	\$18.00	\$2,500.00	- 23.69%	10/22/21 at 09:54:10.639514943	\$24.01		
10/22/21	09:54:11.259756644	75	\$23.00	\$23.18	64,945	\$18.00	\$2,500.00	- 23.69%	10/22/21 at 09:54:10.639514943	\$24.01		
10/22/21	09:54:11.259756644	200	\$23.00	\$23.18	64,945	\$18.00	\$2,500.00	- 23.69%	10/22/21 at 09:54:10.639514943	\$24.01		
10/22/21	09:54:11.261301532	100	\$22.99	\$23.15	64,945	\$18.00	\$2,500.00	- 23.69%	10/22/21 at 09:54:10.639514943	\$24.01	10/22/21 at 09:54:11.546257643	\$23.00
10/22/21	09:54:11.261301532	26	\$22.99	\$23.15	64,945	\$18.00	\$2,500.00	- 23.69%	10/22/21 at 09:54:10.639514943	\$24.01	10/22/21 at 09:54:11.546257643	\$23.00
10/22/21	09:54:11.270913015	21	\$22.97	\$23.15	64,945	\$18.00	\$2,500.00	- 23.69%	10/22/21 at 09:54:10.639514943	\$24.01	10/22/21 at 09:54:11.546257643	\$23.00
10/22/21	09:54:11.270913015	3	\$22.97	\$23.15	64,945	\$18.00	\$2,500.00	- 23.69%	10/22/21 at 09:54:10.639514943	\$24.01	10/22/21 at 09:54:11.546257643	\$23.00
10/22/21	09:54:11.919529349	27	\$23.00	\$23.20	65,055	\$18.00	\$2,500.00	- 23.69%	10/22/21 at 09:54:10.639514943	\$24.01		
10/22/21	09:54:11.943172231	691	\$23.00	\$23.15	63,230	\$18.00	\$2,500.00	- 23.69%	10/22/21 at 09:54:10.639514943	\$24.01		

Date	Executing Purchase			Best Offer (NBBO Quote)	Baiting Orders			Price Decline <sup>1</sup>	Prior Sale by Defendant <sup>2</sup>		Next Sale by Defendant <sup>2</sup>	
	Time	Volume	Price <sup>3</sup>		Volume <sup>4</sup>	Min. Price <sup>5</sup>	Max. Price <sup>5</sup>		Time	Price	Time	Price
10/22/21	09:54:11.945664161	282	\$23.00	\$23.15	63,230	\$18.00	\$2,500.00	- 23.69%	10/22/21 at 09:54:10.639514943	\$24.01		
10/22/21	10:43:22.483206260	281	\$11.09	\$11.10	78,867	\$9.00	\$300.00	- 30.60%	10/22/21 at 09:54:11.546282355	\$23.00	10/22/21 at 10:48:22.714015217	\$11.48
10/22/21	10:43:22.626997122	120	\$11.09	\$11.10	78,867	\$9.00	\$300.00	- 30.60%	10/22/21 at 09:54:11.546282355	\$23.00	10/22/21 at 10:48:22.714015217	\$11.48
10/22/21	10:43:22.689290270	599	\$11.09	\$11.10	78,867	\$9.00	\$300.00	- 30.60%	10/22/21 at 09:54:11.546282355	\$23.00	10/22/21 at 10:48:22.714015217	\$11.48
10/22/21	10:43:22.689290270	100	\$11.09	\$11.10	78,867	\$9.00	\$300.00	- 30.60%	10/22/21 at 09:54:11.546282355	\$23.00	10/22/21 at 10:48:22.714015217	\$11.48
10/22/21	10:48:22.729762992	2	\$11.70	\$11.70	48,658	\$12.00	\$1,000.00	- 20.86%	10/22/21 at 09:54:11.546282355	\$23.00	10/22/21 at 10:48:22.734312654	\$11.84
10/22/21	10:57:21.002926487	10	\$9.97	\$9.99	42,155	\$9.90	\$1,000.00	- 10.51%	10/22/21 at 10:57:20.995245374	\$10.00	10/25/21 at 09:30:03.399450614	\$12.00
10/22/21	10:57:21.002926487	10	\$9.96	\$9.99	42,155	\$9.90	\$1,000.00	- 10.51%	10/22/21 at 10:57:20.995245374	\$10.00	10/25/21 at 09:30:03.399450614	\$12.00
10/22/21	10:57:21.002926487	200	\$9.92	\$9.99	42,155	\$9.90	\$1,000.00	- 10.51%	10/22/21 at 10:57:20.995245374	\$10.00	10/25/21 at 09:30:03.399450614	\$12.00
10/22/21	10:57:21.002926487	1,000	\$9.95	\$9.99	42,155	\$9.90	\$1,000.00	- 10.51%	10/22/21 at 10:57:20.995245374	\$10.00	10/25/21 at 09:30:03.399450614	\$12.00
10/22/21	10:57:21.002926487	15	\$9.97	\$9.99	42,155	\$9.90	\$1,000.00	- 10.51%	10/22/21 at 10:57:20.995245374	\$10.00	10/25/21 at 09:30:03.399450614	\$12.00
10/22/21	10:57:21.002926487	10	\$9.95	\$9.99	42,155	\$9.90	\$1,000.00	- 10.51%	10/22/21 at 10:57:20.995245374	\$10.00	10/25/21 at 09:30:03.399450614	\$12.00
10/22/21	10:57:21.009516991	10	\$9.91	\$10.00	42,155	\$9.90	\$1,000.00	- 10.51%	10/22/21 at 10:57:20.995245374	\$10.00	10/25/21 at 09:30:03.399450614	\$12.00
10/22/21	10:57:21.016197344	100	\$9.90	\$10.00	42,155	\$9.90	\$1,000.00	- 10.51%	10/22/21 at 10:57:20.995245374	\$10.00	10/25/21 at 09:30:03.399450614	\$12.00
10/22/21	10:57:21.016197344	50	\$9.90	\$10.00	42,155	\$9.90	\$1,000.00	- 10.51%	10/22/21 at 10:57:20.995245374	\$10.00	10/25/21 at 09:30:03.399450614	\$12.00
10/22/21	10:57:21.020688355	385	\$9.90	\$10.00	42,175	\$9.90	\$1,000.00	- 10.51%	10/22/21 at 10:57:20.995245374	\$10.00	10/25/21 at 09:30:03.399450614	\$12.00
10/22/21	10:57:21.025883286	50	\$9.88	\$9.98	43,106	\$10.00	\$1,000.00	- 10.51%	10/22/21 at 10:57:21.025627865	\$9.90	10/25/21 at 09:30:03.399450614	\$12.00
10/22/21	10:57:21.025883286	1	\$9.88	\$9.98	43,106	\$10.00	\$1,000.00	- 10.51%	10/22/21 at 10:57:21.025627865	\$9.90	10/25/21 at 09:30:03.399450614	\$12.00
10/22/21	10:57:21.060299357	2,700	\$9.85	\$9.88	46,922	\$10.00	\$1,000.00	- 10.51%	10/22/21 at 10:57:21.025627865	\$9.90	10/25/21 at 09:30:03.399450614	\$12.00

Date	Executing Purchase			Best Offer (NBBO Quote)	Baiting Orders			Price Decline <sup>1</sup>	Prior Sale by Defendant <sup>2</sup>		Next Sale by Defendant <sup>2</sup>	
	Time	Volume	Price <sup>3</sup>		Volume <sup>4</sup>	Min. Price <sup>5</sup>	Max. Price <sup>5</sup>		Time	Price	Time	Price
10/22/21	10:57:21.060299357	80	\$9.85	\$9.88	46,922	\$10.00	\$1,000.00	- 10.51%	10/22/21 at 10:57:21.025627865	\$9.90	10/25/21 at 09:30:03.399450614	\$12.00
10/22/21	10:57:21.102435303	5	\$9.80	\$9.85	46,922	\$10.00	\$1,000.00	- 10.51%	10/22/21 at 10:57:21.025627865	\$9.90	10/25/21 at 09:30:03.399450614	\$12.00
10/22/21	10:57:21.102435303	32	\$9.80	\$9.85	46,922	\$10.00	\$1,000.00	- 10.51%	10/22/21 at 10:57:21.025627865	\$9.90	10/25/21 at 09:30:03.399450614	\$12.00
10/22/21	10:57:21.105097317	368	\$9.80	\$9.83	46,922	\$10.00	\$1,000.00	- 10.51%	10/22/21 at 10:57:21.025627865	\$9.90	10/25/21 at 09:30:03.399450614	\$12.00
10/22/21	10:57:21.105097317	100	\$9.80	\$9.83	46,922	\$10.00	\$1,000.00	- 10.51%	10/22/21 at 10:57:21.025627865	\$9.90	10/25/21 at 09:30:03.399450614	\$12.00
10/22/21	10:57:21.105097317	200	\$9.80	\$9.83	46,922	\$10.00	\$1,000.00	- 10.51%	10/22/21 at 10:57:21.025627865	\$9.90	10/25/21 at 09:30:03.399450614	\$12.00
10/22/21	10:57:21.105444839	71	\$9.80	\$9.83	46,922	\$10.00	\$1,000.00	- 10.51%	10/22/21 at 10:57:21.025627865	\$9.90	10/25/21 at 09:30:03.399450614	\$12.00
10/22/21	10:57:21.105504660	10	\$9.80	\$9.83	46,922	\$10.00	\$1,000.00	- 10.51%	10/22/21 at 10:57:21.025627865	\$9.90	10/25/21 at 09:30:03.399450614	\$12.00
10/22/21	10:57:21.105513834	419	\$9.80	\$9.83	46,922	\$10.00	\$1,000.00	- 10.51%	10/22/21 at 10:57:21.025627865	\$9.90	10/25/21 at 09:30:03.399450614	\$12.00
10/22/21	10:57:21.105513834	108	\$9.80	\$9.83	46,922	\$10.00	\$1,000.00	- 10.51%	10/22/21 at 10:57:21.025627865	\$9.90	10/25/21 at 09:30:03.399450614	\$12.00
10/22/21	10:57:21.111131241	100	\$9.79	\$9.83	46,922	\$10.00	\$1,000.00	- 10.51%	10/22/21 at 10:57:21.025627865	\$9.90	10/25/21 at 09:30:03.399450614	\$12.00
10/22/21	10:57:21.114919708	25	\$9.75	\$9.83	46,922	\$10.00	\$1,000.00	- 10.51%	10/22/21 at 10:57:21.025627865	\$9.90	10/25/21 at 09:30:03.399450614	\$12.00
10/22/21	10:57:21.114919708	150	\$9.75	\$9.83	46,922	\$10.00	\$1,000.00	- 10.51%	10/22/21 at 10:57:21.025627865	\$9.90	10/25/21 at 09:30:03.399450614	\$12.00
10/22/21	10:57:21.119042643	34	\$9.73	\$9.83	46,922	\$10.00	\$1,000.00	- 10.51%	10/22/21 at 10:57:21.025627865	\$9.90	10/25/21 at 09:30:03.399450614	\$12.00
10/22/21	10:57:21.119576662	100	\$9.70	\$9.83	46,922	\$10.00	\$1,000.00	- 10.51%	10/22/21 at 10:57:21.025627865	\$9.90	10/25/21 at 09:30:03.399450614	\$12.00
10/22/21	10:57:21.119576662	100	\$9.70	\$9.83	46,922	\$10.00	\$1,000.00	- 10.51%	10/22/21 at 10:57:21.025627865	\$9.90	10/25/21 at 09:30:03.399450614	\$12.00
10/22/21	10:57:21.125710547	230	\$9.70	\$9.83	46,422	\$10.00	\$1,000.00	- 10.51%	10/22/21 at 10:57:21.025627865	\$9.90	10/25/21 at 09:30:03.399450614	\$12.00
10/22/21	10:57:21.133818070	100	\$9.69	\$9.83	46,422	\$10.00	\$1,000.00	- 10.51%	10/22/21 at 10:57:21.025627865	\$9.90	10/25/21 at 09:30:03.399450614	\$12.00
10/22/21	10:57:21.135950903	8	\$9.68	\$9.83	46,422	\$10.00	\$1,000.00	- 10.51%	10/22/21 at 10:57:21.025627865	\$9.90	10/25/21 at 09:30:03.399450614	\$12.00

Date	Executing Purchase			Best Offer (NBBO Quote)	Baiting Orders			Price Decline <sup>1</sup>	Prior Sale by Defendant <sup>2</sup>		Next Sale by Defendant <sup>2</sup>	
	Time	Volume	Price <sup>3</sup>		Volume <sup>4</sup>	Min. Price <sup>5</sup>	Max. Price <sup>5</sup>		Time	Price	Time	Price
10/22/21	10:57:21.136006234	22	\$9.68	\$9.83	46,422	\$10.00	\$1,000.00	-10.51%	10/22/21 at 10:57:21.025627865	\$9.90	10/25/21 at 09:30:03.399450614	\$12.00
10/22/21	10:57:21.136006234	50	\$9.67	\$9.83	46,422	\$10.00	\$1,000.00	-10.51%	10/22/21 at 10:57:21.025627865	\$9.90	10/25/21 at 09:30:03.399450614	\$12.00
10/22/21	10:57:21.272905399	101	\$9.60	\$9.80	46,676	\$10.00	\$1,000.00	-10.51%	10/22/21 at 10:57:21.025627865	\$9.90	10/25/21 at 09:30:03.399450614	\$12.00
10/22/21	10:57:21.331982286	450	\$9.56	\$9.80	46,676	\$10.00	\$1,000.00	-10.51%	10/22/21 at 10:57:21.025627865	\$9.90	10/25/21 at 09:30:03.399450614	\$12.00
10/22/21	15:55:33.708640739	500	\$8.67	\$8.68	25,943	\$8.73	\$60.00	-1.71%	10/22/21 at 15:55:05.457128790	\$8.70	10/22/21 at 15:56:06.187436747	\$8.70
10/22/21	15:56:21.580517247	100	\$8.77	\$8.79	23,311	\$8.77	\$60.00	-2.60%	10/22/21 at 15:56:18.497800821	\$8.81	10/22/21 at 15:56:21.847821324	\$8.78
10/22/21	15:58:04.251469230	1	\$8.70	\$8.75	52,702	\$8.74	\$38.08	-3.04%	10/22/21 at 15:57:59.641786432	\$8.77	10/22/21 at 15:58:38.749683572	\$8.72
10/22/21	15:58:04.251469230	100	\$8.70	\$8.75	52,702	\$8.74	\$38.08	-3.04%	10/22/21 at 15:57:59.641786432	\$8.77	10/22/21 at 15:58:38.749683572	\$8.72
10/22/21	15:58:04.251469230	101	\$8.70	\$8.75	52,702	\$8.74	\$38.08	-3.04%	10/22/21 at 15:57:59.641786432	\$8.77	10/22/21 at 15:58:38.749683572	\$8.72
10/22/21	15:58:04.251469230	300	\$8.70	\$8.75	52,702	\$8.74	\$38.08	-3.04%	10/22/21 at 15:57:59.641786432	\$8.77	10/22/21 at 15:58:38.749683572	\$8.72
10/25/21	09:30:01.865029416	23	\$11.98	\$12.00	1,114	\$10.70	\$110.00	-10.08%	10/22/21 at 09:54:11.546282355	\$23.00	10/25/21 at 09:30:03.399450614	\$12.00
10/25/21	09:30:01.865569334	477	\$11.98	\$12.00	1,114	\$10.70	\$110.00	-10.08%	10/22/21 at 09:54:11.546282355	\$23.00	10/25/21 at 09:30:03.399450614	\$12.00
10/25/21	09:30:02.056863617	984	\$11.97	\$12.00	1,114	\$10.70	\$110.00	-10.08%	10/22/21 at 09:54:11.546282355	\$23.00	10/25/21 at 09:30:03.399450614	\$12.00
10/25/21	09:30:02.057846013	1,500	\$11.97	\$12.00	1,114	\$10.70	\$110.00	-10.08%	10/22/21 at 09:54:11.546282355	\$23.00	10/25/21 at 09:30:03.399450614	\$12.00
10/25/21	09:30:02.057883748	116	\$11.97	\$12.00	1,114	\$10.70	\$110.00	-10.08%	10/22/21 at 09:54:11.546282355	\$23.00	10/25/21 at 09:30:03.399450614	\$12.00
10/25/21	09:30:03.803394207	1	\$11.95	\$11.99	4,814	\$10.70	\$110.00	-10.08%	10/25/21 at 09:30:03.803337635	\$12.00	10/25/21 at 09:30:03.803818142	\$12.00
10/25/21	09:30:03.804002448	400	\$11.96	\$11.99	4,814	\$10.70	\$110.00	-10.08%	10/25/21 at 09:30:03.803988549	\$12.00	10/25/21 at 09:30:04.487026623	\$11.98
10/25/21	09:30:03.804002448	100	\$11.97	\$11.99	4,814	\$10.70	\$110.00	-10.08%	10/25/21 at 09:30:03.803988549	\$12.00	10/25/21 at 09:30:04.487026623	\$11.98
10/25/21	09:30:03.804002448	50	\$11.95	\$11.99	4,814	\$10.70	\$110.00	-10.08%	10/25/21 at 09:30:03.803988549	\$12.00	10/25/21 at 09:30:04.487026623	\$11.98

Date	Executing Purchase			Best Offer (NBBO Quote)	Baiting Orders			Price Decline <sup>1</sup>	Prior Sale by Defendant <sup>2</sup>		Next Sale by Defendant <sup>2</sup>	
	Time	Volume	Price <sup>3</sup>		Volume <sup>4</sup>	Min. Price <sup>5</sup>	Max. Price <sup>5</sup>		Time	Price	Time	Price
10/25/21	09:30:03.804002448	100	\$11.96	\$11.99	4,814	\$10.70	\$110.00	- 10.08%	10/25/21 at 09:30:03.803988549	\$12.00	10/25/21 at 09:30:04.487026623	\$11.98
10/25/21	09:30:03.804002448	1	\$11.96	\$11.99	4,814	\$10.70	\$110.00	- 10.08%	10/25/21 at 09:30:03.803988549	\$12.00	10/25/21 at 09:30:04.487026623	\$11.98
10/25/21	09:30:03.804002448	20	\$11.95	\$11.99	4,814	\$10.70	\$110.00	- 10.08%	10/25/21 at 09:30:03.803988549	\$12.00	10/25/21 at 09:30:04.487026623	\$11.98
10/25/21	09:30:03.804002448	41	\$11.96	\$11.99	4,814	\$10.70	\$110.00	- 10.08%	10/25/21 at 09:30:03.803988549	\$12.00	10/25/21 at 09:30:04.487026623	\$11.98
10/25/21	09:30:03.804002448	250	\$11.96	\$11.99	4,814	\$10.70	\$110.00	- 10.08%	10/25/21 at 09:30:03.803988549	\$12.00	10/25/21 at 09:30:04.487026623	\$11.98
10/25/21	09:30:03.804002448	50	\$11.95	\$11.99	4,814	\$10.70	\$110.00	- 10.08%	10/25/21 at 09:30:03.803988549	\$12.00	10/25/21 at 09:30:04.487026623	\$11.98
10/25/21	09:30:03.804002448	250	\$11.97	\$11.99	4,814	\$10.70	\$110.00	- 10.08%	10/25/21 at 09:30:03.803988549	\$12.00	10/25/21 at 09:30:04.487026623	\$11.98
10/25/21	09:30:03.804155282	100	\$11.94	\$11.95	5,814	\$10.70	\$110.00	- 10.08%	10/25/21 at 09:30:03.803988549	\$12.00	10/25/21 at 09:30:03.860782653	\$11.95
10/25/21	09:30:03.804631154	50	\$11.95	\$11.99	8,149	\$10.70	\$110.00	- 10.08%	10/25/21 at 09:30:03.803988549	\$12.00	10/25/21 at 09:30:04.487026623	\$11.98
10/25/21	09:30:03.804663455	52	\$11.94	\$11.99	8,149	\$10.70	\$110.00	- 10.08%	10/25/21 at 09:30:03.803988549	\$12.00	10/25/21 at 09:30:03.860782653	\$11.95
10/25/21	09:30:03.804730706	48	\$11.94	\$11.99	10,883	\$10.70	\$110.00	- 10.08%	10/25/21 at 09:30:03.803988549	\$12.00	10/25/21 at 09:30:03.860782653	\$11.95
10/25/21	09:30:03.810616735	40	\$11.93	\$11.99	11,808	\$10.70	\$110.00	- 10.08%	10/25/21 at 09:30:03.803988549	\$12.00	10/25/21 at 09:30:03.860782653	\$11.95
10/25/21	09:30:03.810616735	8	\$11.93	\$11.99	11,808	\$10.70	\$110.00	- 10.08%	10/25/21 at 09:30:03.803988549	\$12.00	10/25/21 at 09:30:03.860782653	\$11.95
10/25/21	09:35:33.952860897	100	\$10.60	\$10.64	101,095	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:30:04.488140990	\$11.98	10/25/21 at 09:35:33.956101867	\$10.65
10/25/21	09:35:33.952861714	10	\$10.60	\$10.64	101,095	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:30:04.488140990	\$11.98	10/25/21 at 09:35:33.956101867	\$10.65
10/25/21	09:35:33.952863628	200	\$10.60	\$10.64	101,095	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:30:04.488140990	\$11.98	10/25/21 at 09:35:33.956101867	\$10.65
10/25/21	09:35:33.952863797	1	\$10.60	\$10.64	101,095	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:30:04.488140990	\$11.98	10/25/21 at 09:35:33.956101867	\$10.65
10/25/21	09:35:33.955479284	6	\$10.62	\$10.65	101,095	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:30:04.488140990	\$11.98	10/25/21 at 09:35:33.956101867	\$10.65
10/25/21	09:35:34.031644506	9	\$10.57	\$10.62	101,195	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.956348245	\$10.65		



Date	Executing Purchase			Best Offer (NBBO Quote)	Baiting Orders			Price Decline <sup>1</sup>	Prior Sale by Defendant <sup>2</sup>		Next Sale by Defendant <sup>2</sup>	
	Time	Volume	Price <sup>3</sup>		Volume <sup>4</sup>	Min. Price <sup>5</sup>	Max. Price <sup>5</sup>		Time	Price	Time	Price
10/25/21	09:35:34.048725323	4	\$10.56	\$10.62	101,195	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.956348245	\$10.65		
10/25/21	09:35:34.079960472	464	\$10.55	\$10.62	102,298	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.956348245	\$10.65		
10/25/21	09:35:34.080007630	536	\$10.55	\$10.62	102,298	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.956348245	\$10.65		
10/25/21	09:35:34.164511956	20	\$10.54	\$10.60	102,298	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.956348245	\$10.65		
10/25/21	09:35:34.190238498	25	\$10.51	\$10.60	102,298	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.956348245	\$10.65		
10/25/21	09:35:34.239707527	5	\$10.50	\$10.55	102,298	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.956348245	\$10.65		
10/25/21	09:35:34.239861610	6	\$10.50	\$10.55	102,298	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.956348245	\$10.65		
10/25/21	09:35:34.239944405	9	\$10.50	\$10.55	102,298	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.956348245	\$10.65		
10/25/21	09:35:34.239944405	91	\$10.50	\$10.55	102,298	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.956348245	\$10.65		
10/25/21	09:35:34.241660132	9	\$10.50	\$10.55	102,298	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.956348245	\$10.65		
10/25/21	09:35:34.241660132	1,000	\$10.50	\$10.55	102,298	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.956348245	\$10.65		
10/25/21	09:35:34.241660132	200	\$10.50	\$10.55	102,298	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.956348245	\$10.65		
10/25/21	09:35:34.241660132	75	\$10.50	\$10.55	102,298	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.956348245	\$10.65		
10/25/21	09:35:34.262706630	425	\$10.50	\$10.55	102,298	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.956348245	\$10.65		
10/25/21	09:35:34.262706630	25	\$10.50	\$10.55	102,298	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.956348245	\$10.65		
10/25/21	09:35:34.264464090	7	\$10.50	\$10.55	102,298	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.956348245	\$10.65		
10/25/21	09:35:34.265955727	468	\$10.50	\$10.55	102,298	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.956348245	\$10.65		
10/25/21	09:35:34.265955727	500	\$10.50	\$10.55	102,298	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.956348245	\$10.65		
10/25/21	09:35:34.265955727	5	\$10.50	\$10.55	102,298	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.956348245	\$10.65		



Date	Executing Purchase			Best Offer (NBBO Quote)	Baiting Orders			Price Decline <sup>1</sup>	Prior Sale by Defendant <sup>2</sup>		Next Sale by Defendant <sup>2</sup>	
	Time	Volume	Price <sup>3</sup>		Volume <sup>4</sup>	Min. Price <sup>5</sup>	Max. Price <sup>5</sup>		Time	Price	Time	Price
10/25/21	09:35:34.265955727	25	\$10.50	\$10.55	102,298	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.956348245	\$10.65		
10/25/21	09:35:34.265955727	100	\$10.50	\$10.55	102,298	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.956348245	\$10.65		
10/25/21	09:35:34.291211374	100	\$10.50	\$10.55	102,298	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.956348245	\$10.65		
10/25/21	09:35:34.291211374	1,000	\$10.50	\$10.55	102,298	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.956348245	\$10.65		
10/25/21	09:35:34.291211374	30	\$10.50	\$10.55	102,298	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.956348245	\$10.65		
10/25/21	09:35:34.345857055	10	\$10.50	\$10.55	102,298	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.956348245	\$10.65		
10/25/21	09:35:34.345857055	143	\$10.50	\$10.55	102,298	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.956348245	\$10.65		
10/25/21	09:35:34.345878166	2	\$10.50	\$10.55	102,298	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.956348245	\$10.65		
10/25/21	09:35:34.345890468	113	\$10.50	\$10.55	102,298	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.956348245	\$10.65		
10/25/21	09:35:34.345947580	1,742	\$10.50	\$10.55	102,298	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.956348245	\$10.65		
10/25/21	09:35:34.345947580	758	\$10.50	\$10.55	102,298	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.956348245	\$10.65		
10/25/21	09:35:34.345959540	14	\$10.50	\$10.55	102,298	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.956348245	\$10.65		
10/25/21	09:35:34.345972099	1,000	\$10.50	\$10.55	102,298	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.956348245	\$10.65		
10/25/21	09:35:34.345984239	10	\$10.50	\$10.55	102,298	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.956348245	\$10.65		
10/25/21	09:35:34.345999706	168	\$10.50	\$10.55	102,298	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.956348245	\$10.65		
10/25/21	09:35:34.346013007	20	\$10.50	\$10.55	102,298	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.956348245	\$10.65		
10/25/21	09:35:34.346027782	981	\$10.50	\$10.55	102,298	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.956348245	\$10.65		
10/25/21	09:35:34.346039930	55	\$10.50	\$10.55	102,298	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.956348245	\$10.65		
10/25/21	09:35:34.346054778	500	\$10.50	\$10.55	102,298	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.956348245	\$10.65		

Date	Executing Purchase			Best Offer (NBBO Quote)	Baiting Orders			Price Decline <sup>1</sup>	Prior Sale by Defendant <sup>2</sup>		Next Sale by Defendant <sup>2</sup>	
	Time	Volume	Price <sup>3</sup>		Volume <sup>4</sup>	Min. Price <sup>5</sup>	Max. Price <sup>5</sup>		Time	Price	Time	Price
10/25/21	09:35:34.346066917	1,111	\$10.50	\$10.55	102,298	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.956348245	\$10.65		
10/25/21	09:35:34.346081069	18	\$10.50	\$10.55	102,298	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.956348245	\$10.65		
10/25/21	09:35:34.353973025	19	\$10.50	\$10.55	102,298	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.956348245	\$10.65		
10/25/21	09:35:34.353989956	32	\$10.50	\$10.55	102,298	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.956348245	\$10.65		
10/25/21	09:35:34.354006181	2	\$10.50	\$10.55	102,298	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.956348245	\$10.65		
10/25/21	09:35:34.354020753	25	\$10.50	\$10.55	102,298	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.956348245	\$10.65		
10/25/21	09:35:34.354035086	100	\$10.50	\$10.55	102,298	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.956348245	\$10.65		
10/25/21	09:35:34.354048829	10	\$10.50	\$10.55	102,298	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.956348245	\$10.65		
10/25/21	09:35:34.354062116	200	\$10.50	\$10.55	102,298	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.956348245	\$10.65		
10/25/21	09:35:34.354167634	77	\$10.50	\$10.55	102,298	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.956348245	\$10.65		
10/25/21	09:35:34.354167634	30	\$10.50	\$10.55	102,298	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.956348245	\$10.65		
10/25/21	09:35:34.354167634	5	\$10.50	\$10.55	102,298	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.956348245	\$10.65		
10/25/21	09:35:34.430830517	7	\$10.50	\$10.55	102,298	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.956348245	\$10.65		
10/25/21	09:35:34.568851339	46	\$10.40	\$10.46	102,076	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.959644602	\$10.50		
10/25/21	09:35:34.591951252	218	\$10.40	\$10.46	102,076	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.959644602	\$10.50		
10/25/21	09:35:34.595688496	100	\$10.40	\$10.46	102,076	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.959644602	\$10.50		
10/25/21	09:35:34.596212580	100	\$10.40	\$10.46	102,076	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.959644602	\$10.50		
10/25/21	09:35:34.596917620	30	\$10.40	\$10.46	102,076	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.959644602	\$10.50		
10/25/21	09:35:34.597341006	506	\$10.40	\$10.46	102,076	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.959644602	\$10.50		

Date	Executing Purchase			Best Offer (NBBO Quote)	Baiting Orders			Price Decline <sup>1</sup>	Prior Sale by Defendant <sup>2</sup>		Next Sale by Defendant <sup>2</sup>	
	Time	Volume	Price <sup>3</sup>		Volume <sup>4</sup>	Min. Price <sup>5</sup>	Max. Price <sup>5</sup>		Time	Price	Time	Price
10/25/21	09:35:34.597341006	500	\$10.40	\$10.46	102,076	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.959644602	\$10.50		
10/25/21	09:35:34.685858172	5	\$10.37	\$10.46	102,076	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.959644602	\$10.50		
10/25/21	09:35:34.712421554	55	\$10.33	\$10.35	102,176	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.959644602	\$10.50		
10/25/21	09:35:34.712421554	15	\$10.33	\$10.35	102,176	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.959644602	\$10.50		
10/25/21	09:35:34.779375531	325	\$10.27	\$10.30	102,126	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.959644602	\$10.50		
10/25/21	09:35:34.780177936	175	\$10.27	\$10.30	102,126	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.959644602	\$10.50		
10/25/21	09:35:34.788012226	45	\$10.26	\$10.30	102,126	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.959644602	\$10.50		
10/25/21	09:35:34.788057747	55	\$10.26	\$10.30	102,126	\$9.53	\$900.00	- 11.71%	10/25/21 at 09:35:33.959644602	\$10.50		
10/25/21	09:41:12.991094220	7	\$9.54	\$9.54	48,247	\$9.34	\$900.00	-3.89%	10/25/21 at 09:35:33.959644602	\$10.50		
10/25/21	09:41:12.991369379	19	\$9.54	\$9.54	48,247	\$9.34	\$900.00	-3.89%	10/25/21 at 09:35:33.959644602	\$10.50		
10/25/21	09:41:12.991410710	200	\$9.54	\$9.54	48,247	\$9.34	\$900.00	-3.89%	10/25/21 at 09:35:33.959644602	\$10.50		
10/25/21	09:41:12.991477221	15	\$9.54	\$9.54	48,247	\$9.34	\$900.00	-3.89%	10/25/21 at 09:35:33.959644602	\$10.50		
10/25/21	09:41:12.991543811	41	\$9.54	\$9.54	48,247	\$9.34	\$900.00	-3.89%	10/25/21 at 09:35:33.959644602	\$10.50		
10/25/21	09:41:12.991556824	500	\$9.54	\$9.54	48,247	\$9.34	\$900.00	-3.89%	10/25/21 at 09:35:33.959644602	\$10.50		
10/25/21	09:41:12.991689170	20	\$9.53	\$9.54	48,247	\$9.34	\$900.00	-3.89%	10/25/21 at 09:35:33.959644602	\$10.50		
10/25/21	09:41:12.991697820	100	\$9.53	\$9.54	48,247	\$9.34	\$900.00	-3.89%	10/25/21 at 09:35:33.959644602	\$10.50		
10/25/21	09:41:12.991706619	100	\$9.53	\$9.54	48,247	\$9.34	\$900.00	-3.89%	10/25/21 at 09:35:33.959644602	\$10.50		
10/25/21	09:41:12.991718370	30	\$9.53	\$9.54	48,247	\$9.34	\$900.00	-3.89%	10/25/21 at 09:35:33.959644602	\$10.50		
10/25/21	09:41:12.991722912	100	\$9.52	\$9.54	48,247	\$9.34	\$900.00	-3.89%	10/25/21 at 09:35:33.959644602	\$10.50		

Date	Executing Purchase			Best Offer (NBBO Quote)	Baiting Orders			Price Decline <sup>1</sup>	Prior Sale by Defendant <sup>2</sup>		Next Sale by Defendant <sup>2</sup>	
	Time	Volume	Price <sup>3</sup>		Volume <sup>4</sup>	Min. Price <sup>5</sup>	Max. Price <sup>5</sup>		Time	Price	Time	Price
10/25/21	09:41:12.991734141	262	\$9.51	\$9.54	48,247	\$9.34	\$900.00	-3.89%	10/25/21 at 09:35:33.959644602	\$10.50		
10/25/21	09:41:12.991750482	15	\$9.50	\$9.54	48,247	\$9.34	\$900.00	-3.89%	10/25/21 at 09:35:33.959644602	\$10.50		
10/25/21	09:41:12.991750891	20	\$9.50	\$9.54	48,247	\$9.34	\$900.00	-3.89%	10/25/21 at 09:35:33.959644602	\$10.50		
10/25/21	09:41:12.991751182	5	\$9.50	\$9.54	48,247	\$9.34	\$900.00	-3.89%	10/25/21 at 09:35:33.959644602	\$10.50		
10/25/21	09:41:12.991752643	100	\$9.50	\$9.54	48,247	\$9.34	\$900.00	-3.89%	10/25/21 at 09:35:33.959644602	\$10.50		
10/25/21	09:41:12.991752882	100	\$9.50	\$9.54	48,247	\$9.34	\$900.00	-3.89%	10/25/21 at 09:35:33.959644602	\$10.50		
10/25/21	09:41:12.991756712	20	\$9.50	\$9.54	48,247	\$9.34	\$900.00	-3.89%	10/25/21 at 09:35:33.959644602	\$10.50		
10/25/21	09:41:12.991757742	100	\$9.50	\$9.54	48,247	\$9.34	\$900.00	-3.89%	10/25/21 at 09:35:33.959644602	\$10.50		
10/25/21	09:41:12.991757924	200	\$9.50	\$9.54	48,247	\$9.34	\$900.00	-3.89%	10/25/21 at 09:35:33.959644602	\$10.50		
10/25/21	09:41:12.991783323	250	\$9.50	\$9.54	48,247	\$9.34	\$900.00	-3.89%	10/25/21 at 09:35:33.959644602	\$10.50		
10/25/21	09:41:12.991785845	50	\$9.50	\$9.54	48,247	\$9.34	\$900.00	-3.89%	10/25/21 at 09:35:33.959644602	\$10.50		
10/25/21	09:41:12.991816427	40	\$9.50	\$9.54	48,247	\$9.34	\$900.00	-3.89%	10/25/21 at 09:35:33.959644602	\$10.50		
10/25/21	09:41:12.991820348	250	\$9.50	\$9.54	48,247	\$9.34	\$900.00	-3.89%	10/25/21 at 09:35:33.959644602	\$10.50		
10/25/21	09:41:12.991822596	50	\$9.50	\$9.54	48,247	\$9.34	\$900.00	-3.89%	10/25/21 at 09:35:33.959644602	\$10.50		
10/25/21	09:41:12.991829879	100	\$9.50	\$9.54	48,247	\$9.34	\$900.00	-3.89%	10/25/21 at 09:35:33.959644602	\$10.50		
10/25/21	09:41:12.991846367	250	\$9.50	\$9.54	48,247	\$9.34	\$900.00	-3.89%	10/25/21 at 09:35:33.959644602	\$10.50		
10/25/21	09:41:12.991847194	20	\$9.50	\$9.54	48,247	\$9.34	\$900.00	-3.89%	10/25/21 at 09:35:33.959644602	\$10.50		
10/25/21	09:41:12.991854370	50	\$9.50	\$9.54	48,247	\$9.34	\$900.00	-3.89%	10/25/21 at 09:35:33.959644602	\$10.50		
10/25/21	09:41:12.991868281	200	\$9.50	\$9.54	48,247	\$9.34	\$900.00	-3.89%	10/25/21 at 09:35:33.959644602	\$10.50		

Date	Executing Purchase			Best Offer (NBBO Quote)	Baiting Orders			Price Decline <sup>1</sup>	Prior Sale by Defendant <sup>2</sup>		Next Sale by Defendant <sup>2</sup>	
	Time	Volume	Price <sup>3</sup>		Volume <sup>4</sup>	Min. Price <sup>5</sup>	Max. Price <sup>5</sup>		Time	Price	Time	Price
10/25/21	09:41:13.000001887	500	\$9.48	\$9.49	48,247	\$9.34	\$900.00	-4.00%	10/25/21 at 09:35:33.959644602	\$10.50	10/25/21 at 09:41:13.016225797	\$9.50
10/25/21	09:41:13.056845310	15	\$9.45	\$9.48	49,596	\$9.34	\$900.00	-4.00%	10/25/21 at 09:41:13.045222113	\$9.46		
10/25/21	09:41:13.071892182	24	\$9.40	\$9.41	49,696	\$9.34	\$900.00	-4.00%	10/25/21 at 09:41:13.045222113	\$9.46		
10/25/21	09:41:13.072161115	100	\$9.40	\$9.41	49,696	\$9.34	\$900.00	-4.00%	10/25/21 at 09:41:13.045222113	\$9.46		
10/25/21	09:41:13.072331715	100	\$9.40	\$9.41	49,696	\$9.34	\$900.00	-4.00%	10/25/21 at 09:41:13.045222113	\$9.46		
10/25/21	09:41:13.072842815	50	\$9.40	\$9.41	49,696	\$9.34	\$900.00	-4.00%	10/25/21 at 09:41:13.045222113	\$9.46		
10/25/21	09:41:13.078064967	226	\$9.40	\$9.48	49,696	\$9.34	\$900.00	-4.00%	10/25/21 at 09:41:13.045222113	\$9.46		
10/25/21	09:41:13.108736429	6	\$9.39	\$9.50	49,696	\$9.34	\$900.00	-4.00%	10/25/21 at 09:41:13.045222113	\$9.46		
10/25/21	09:41:13.109086728	100	\$9.39	\$9.50	49,696	\$9.34	\$900.00	-4.00%	10/25/21 at 09:41:13.045222113	\$9.46		
10/25/21	09:41:13.115079710	30	\$9.39	\$9.50	49,696	\$9.34	\$900.00	-4.00%	10/25/21 at 09:41:13.045222113	\$9.46		
10/25/21	09:41:13.115512876	90	\$9.39	\$9.50	49,696	\$9.34	\$900.00	-4.00%	10/25/21 at 09:41:13.045222113	\$9.46		
10/25/21	09:41:13.115631673	20	\$9.39	\$9.50	49,696	\$9.34	\$900.00	-4.00%	10/25/21 at 09:41:13.045222113	\$9.46		
10/25/21	09:41:13.115719481	100	\$9.39	\$9.50	49,696	\$9.34	\$900.00	-4.00%	10/25/21 at 09:41:13.045222113	\$9.46		
10/25/21	09:41:13.115763602	99	\$9.39	\$9.50	49,696	\$9.34	\$900.00	-4.00%	10/25/21 at 09:41:13.045222113	\$9.46		
10/25/21	09:41:13.122239707	40	\$9.39	\$9.50	49,696	\$9.34	\$900.00	-4.00%	10/25/21 at 09:41:13.045222113	\$9.46		
10/25/21	09:41:13.123344403	433	\$9.39	\$9.50	49,696	\$9.34	\$900.00	-4.00%	10/25/21 at 09:41:13.045222113	\$9.46		
10/25/21	09:41:13.124279696	50	\$9.39	\$9.50	49,696	\$9.34	\$900.00	-4.00%	10/25/21 at 09:41:13.045222113	\$9.46		
10/25/21	09:41:13.124324877	32	\$9.39	\$9.50	49,696	\$9.34	\$900.00	-4.00%	10/25/21 at 09:41:13.045222113	\$9.46		
10/25/21	09:41:13.164304484	246	\$9.38	\$9.50	49,696	\$9.34	\$900.00	-4.00%	10/25/21 at 09:41:13.045222113	\$9.46		

Date	Executing Purchase			Best Offer (NBBO Quote)	Baiting Orders			Price Decline <sup>1</sup>	Prior Sale by Defendant <sup>2</sup>		Next Sale by Defendant <sup>2</sup>	
	Time	Volume	Price <sup>3</sup>		Volume <sup>4</sup>	Min. Price <sup>5</sup>	Max. Price <sup>5</sup>		Time	Price	Time	Price
10/25/21	09:41:13.164388665	35	\$9.38	\$9.50	49,696	\$9.34	\$900.00	-4.00%	10/25/21 at 09:41:13.045222113	\$9.46		
10/25/21	09:41:13.164464428	100	\$9.38	\$9.50	49,696	\$9.34	\$900.00	-4.00%	10/25/21 at 09:41:13.045222113	\$9.46		
10/25/21	09:41:13.164583459	360	\$9.38	\$9.50	49,696	\$9.34	\$900.00	-4.00%	10/25/21 at 09:41:13.045222113	\$9.46		
10/25/21	09:41:13.164662155	500	\$9.38	\$9.50	49,696	\$9.34	\$900.00	-4.00%	10/25/21 at 09:41:13.045222113	\$9.46		
10/25/21	09:41:13.166674365	20	\$9.38	\$9.50	49,696	\$9.34	\$900.00	-4.00%	10/25/21 at 09:41:13.045222113	\$9.46		
10/25/21	09:41:13.168042265	1,239	\$9.38	\$9.50	49,696	\$9.34	\$900.00	-4.00%	10/25/21 at 09:41:13.045222113	\$9.46		
10/25/21	09:41:13.897424187	78	\$9.30	\$9.34	52,508	\$9.51	\$900.00	-4.00%	10/25/21 at 09:41:13.045222113	\$9.46	10/25/21 at 09:41:13.909169345	\$9.31
10/25/21	09:41:13.904720103	10	\$9.30	\$9.34	52,508	\$9.51	\$900.00	-4.00%	10/25/21 at 09:41:13.045222113	\$9.46	10/25/21 at 09:41:13.909169345	\$9.31
10/25/21	09:41:13.931129545	10	\$9.30	\$9.34	52,508	\$9.51	\$900.00	-4.00%	10/25/21 at 09:41:13.909169345	\$9.31	10/25/21 at 09:41:14.026781157	\$9.34
10/25/21	09:41:13.961806980	48	\$9.30	\$9.34	52,508	\$9.51	\$900.00	-4.00%	10/25/21 at 09:41:13.909169345	\$9.31	10/25/21 at 09:41:14.026781157	\$9.34
10/25/21	09:41:13.962833161	30	\$9.30	\$9.34	52,508	\$9.51	\$900.00	-4.00%	10/25/21 at 09:41:13.909169345	\$9.31	10/25/21 at 09:41:14.026781157	\$9.34
10/25/21	09:41:13.993889691	100	\$9.30	\$9.34	52,508	\$9.51	\$900.00	-4.00%	10/25/21 at 09:41:13.909169345	\$9.31	10/25/21 at 09:41:14.026781157	\$9.34
10/25/21	09:41:13.994109011	100	\$9.30	\$9.34	52,508	\$9.51	\$900.00	-4.00%	10/25/21 at 09:41:13.909169345	\$9.31	10/25/21 at 09:41:14.026781157	\$9.34
10/25/21	10:05:57.402023162	40	\$8.21	\$8.23	30,103	\$8.41	\$900.00	-6.02%	10/25/21 at 10:05:57.381245522	\$8.25	10/25/21 at 10:05:57.522919301	\$8.31
10/25/21	10:05:57.402159369	250	\$8.21	\$8.23	30,103	\$8.41	\$900.00	-6.02%	10/25/21 at 10:05:57.381245522	\$8.25	10/25/21 at 10:05:57.522919301	\$8.31
10/25/21	10:05:57.402418172	71	\$8.21	\$8.22	30,103	\$8.41	\$900.00	-6.02%	10/25/21 at 10:05:57.381245522	\$8.25	10/25/21 at 10:05:57.522919301	\$8.31
10/26/21	09:30:01.123261793	10	\$6.33	\$6.34	904	\$6.75	\$300.00	-12.19%	10/25/21 at 16:00:00.645226073	\$7.15	10/26/21 at 09:30:21.487096897	\$6.40
10/26/21	09:30:01.123261793	490	\$6.33	\$6.34	904	\$6.75	\$300.00	-12.19%	10/25/21 at 16:00:00.645226073	\$7.15	10/26/21 at 09:30:21.487096897	\$6.40
10/26/21	09:30:01.133720521	5	\$6.33	\$6.34	904	\$6.75	\$300.00	-12.19%	10/25/21 at 16:00:00.645226073	\$7.15	10/26/21 at 09:30:21.487096897	\$6.40

Date	Executing Purchase			Best Offer (NBBO Quote)	Baiting Orders			Price Decline <sup>1</sup>	Prior Sale by Defendant <sup>2</sup>		Next Sale by Defendant <sup>2</sup>	
	Time	Volume	Price <sup>3</sup>		Volume <sup>4</sup>	Min. Price <sup>5</sup>	Max. Price <sup>5</sup>		Time	Price	Time	Price
10/26/21	09:30:01.133736874	44	\$6.33	\$6.34	904	\$6.75	\$300.00	- 12.19%	10/25/21 at 16:00:00.645226073	\$7.15	10/26/21 at 09:30:21.487096897	\$6.40
10/26/21	09:30:01.134775615	105	\$6.33	\$6.34	904	\$6.75	\$300.00	- 12.19%	10/25/21 at 16:00:00.645226073	\$7.15	10/26/21 at 09:30:21.487096897	\$6.40
10/26/21	09:30:01.152919955	28	\$6.33	\$6.34	904	\$6.75	\$300.00	- 12.19%	10/25/21 at 16:00:00.645226073	\$7.15	10/26/21 at 09:30:21.487096897	\$6.40
10/26/21	09:30:01.152943204	25	\$6.33	\$6.34	904	\$6.75	\$300.00	- 12.19%	10/25/21 at 16:00:00.645226073	\$7.15	10/26/21 at 09:30:21.487096897	\$6.40
10/26/21	09:30:01.154147270	51	\$6.33	\$6.34	904	\$6.75	\$300.00	- 12.19%	10/25/21 at 16:00:00.645226073	\$7.15	10/26/21 at 09:30:21.487096897	\$6.40
10/26/21	09:30:01.154164000	26	\$6.33	\$6.34	904	\$6.75	\$300.00	- 12.19%	10/25/21 at 16:00:00.645226073	\$7.15	10/26/21 at 09:30:21.487096897	\$6.40
10/26/21	09:30:01.179301680	414	\$6.33	\$6.34	904	\$6.75	\$300.00	- 12.19%	10/25/21 at 16:00:00.645226073	\$7.15	10/26/21 at 09:30:21.487096897	\$6.40
10/26/21	09:30:01.183062445	1,400	\$6.33	\$6.34	904	\$6.75	\$300.00	- 12.19%	10/25/21 at 16:00:00.645226073	\$7.15	10/26/21 at 09:30:21.487096897	\$6.40
10/26/21	09:30:01.191783541	414	\$6.33	\$6.34	904	\$6.75	\$300.00	- 12.19%	10/25/21 at 16:00:00.645226073	\$7.15	10/26/21 at 09:30:21.487096897	\$6.40
10/26/21	09:30:01.201872359	10	\$6.33	\$6.34	904	\$6.75	\$300.00	- 12.19%	10/25/21 at 16:00:00.645226073	\$7.15	10/26/21 at 09:30:21.487096897	\$6.40
10/26/21	09:30:01.204189928	454	\$6.33	\$6.34	904	\$6.75	\$300.00	- 12.19%	10/25/21 at 16:00:00.645226073	\$7.15	10/26/21 at 09:30:21.487096897	\$6.40
10/26/21	09:30:01.212081306	230	\$6.33	\$6.34	904	\$6.75	\$300.00	- 12.19%	10/25/21 at 16:00:00.645226073	\$7.15	10/26/21 at 09:30:21.487096897	\$6.40
10/26/21	09:30:01.216472544	34	\$6.33	\$6.34	904	\$6.75	\$300.00	- 12.19%	10/25/21 at 16:00:00.645226073	\$7.15	10/26/21 at 09:30:21.487096897	\$6.40
10/26/21	09:30:01.216489917	400	\$6.33	\$6.34	904	\$6.75	\$300.00	- 12.19%	10/25/21 at 16:00:00.645226073	\$7.15	10/26/21 at 09:30:21.487096897	\$6.40
10/26/21	09:30:01.216517812	383	\$6.33	\$6.34	904	\$6.75	\$300.00	- 12.19%	10/25/21 at 16:00:00.645226073	\$7.15	10/26/21 at 09:30:21.487096897	\$6.40
10/26/21	09:30:01.327083632	3,850	\$6.33	\$6.34	12,251	\$6.75	\$300.00	- 12.19%	10/25/21 at 16:00:00.645226073	\$7.15	10/26/21 at 09:30:21.487096897	\$6.40
10/26/21	09:30:01.341410104	16	\$6.33	\$6.36	12,251	\$6.75	\$300.00	- 12.19%	10/25/21 at 16:00:00.645226073	\$7.15	10/26/21 at 09:30:21.487096897	\$6.40
10/26/21	09:30:01.350918842	5	\$6.33	\$6.36	12,251	\$6.75	\$300.00	- 12.19%	10/25/21 at 16:00:00.645226073	\$7.15	10/26/21 at 09:30:21.487096897	\$6.40
10/26/21	09:30:01.351192029	100	\$6.33	\$6.36	12,251	\$6.75	\$300.00	- 12.19%	10/25/21 at 16:00:00.645226073	\$7.15	10/26/21 at 09:30:21.487096897	\$6.40



Date	Executing Purchase			Best Offer (NBBO Quote)	Baiting Orders			Price Decline <sup>1</sup>	Prior Sale by Defendant <sup>2</sup>		Next Sale by Defendant <sup>2</sup>	
	Time	Volume	Price <sup>3</sup>		Volume <sup>4</sup>	Min. Price <sup>5</sup>	Max. Price <sup>5</sup>		Time	Price	Time	Price
10/26/21	09:30:01.354482310	109	\$6.33	\$6.36	12,251	\$6.75	\$300.00	- 12.19%	10/25/21 at 16:00:00.645226073	\$7.15	10/26/21 at 09:30:21.487096897	\$6.40
10/26/21	09:30:01.356464247	407	\$6.33	\$6.36	12,251	\$6.75	\$300.00	- 12.19%	10/25/21 at 16:00:00.645226073	\$7.15	10/26/21 at 09:30:21.487096897	\$6.40
10/26/21	09:30:01.356464247	100	\$6.33	\$6.36	12,251	\$6.75	\$300.00	- 12.19%	10/25/21 at 16:00:00.645226073	\$7.15	10/26/21 at 09:30:21.487096897	\$6.40
10/26/21	09:30:04.386483797	100	\$6.30	\$6.31	13,188	\$6.75	\$300.00	- 12.19%	10/25/21 at 16:00:00.645226073	\$7.15	10/26/21 at 09:30:21.487096897	\$6.40
10/26/21	09:30:04.418685844	100	\$6.26	\$6.27	13,288	\$6.75	\$300.00	- 12.19%	10/25/21 at 16:00:00.645226073	\$7.15	10/26/21 at 09:30:21.487096897	\$6.40
10/26/21	09:30:04.427209384	300	\$6.25	\$6.26	13,288	\$6.75	\$300.00	- 12.19%	10/25/21 at 16:00:00.645226073	\$7.15	10/26/21 at 09:30:21.487096897	\$6.40
10/26/21	09:30:04.427209384	1	\$6.25	\$6.26	13,288	\$6.75	\$300.00	- 12.19%	10/25/21 at 16:00:00.645226073	\$7.15	10/26/21 at 09:30:21.487096897	\$6.40
10/26/21	09:30:04.427209384	50	\$6.25	\$6.26	13,288	\$6.75	\$300.00	- 12.19%	10/25/21 at 16:00:00.645226073	\$7.15	10/26/21 at 09:30:21.487096897	\$6.40
10/26/21	09:30:08.012529379	161	\$6.21	\$6.23	13,779	\$6.75	\$300.00	- 12.19%	10/25/21 at 16:00:00.645226073	\$7.15	10/26/21 at 09:30:21.487096897	\$6.40
10/26/21	09:30:08.013924120	1,000	\$6.20	\$6.21	13,779	\$6.75	\$300.00	- 12.19%	10/25/21 at 16:00:00.645226073	\$7.15	10/26/21 at 09:30:21.487096897	\$6.40
10/26/21	09:30:08.014399831	10	\$6.19	\$6.21	13,779	\$6.75	\$300.00	- 12.19%	10/25/21 at 16:00:00.645226073	\$7.15	10/26/21 at 09:30:21.487096897	\$6.40
10/26/21	09:30:08.014758102	40	\$6.19	\$6.21	13,779	\$6.75	\$300.00	- 12.19%	10/25/21 at 16:00:00.645226073	\$7.15	10/26/21 at 09:30:21.487096897	\$6.40
10/26/21	09:30:08.014758102	1	\$6.19	\$6.21	13,779	\$6.75	\$300.00	- 12.19%	10/25/21 at 16:00:00.645226073	\$7.15	10/26/21 at 09:30:21.487096897	\$6.40
10/26/21	09:30:10.318991341	2,000	\$6.15	\$6.16	13,924	\$6.75	\$300.00	- 12.19%	10/25/21 at 16:00:00.645226073	\$7.15	10/26/21 at 09:30:21.487096897	\$6.40
10/26/21	09:30:10.348146877	50	\$6.11	\$6.12	13,924	\$6.75	\$300.00	- 12.19%	10/25/21 at 16:00:00.645226073	\$7.15	10/26/21 at 09:30:21.487096897	\$6.40
10/27/21	09:30:36.323727460	824	\$4.85	\$4.87	19,820	\$5.09	\$25.00	-4.35%	10/26/21 at 11:28:44.990096160	\$4.89	10/27/21 at 09:31:07.981451822	\$4.99
10/27/21	09:30:36.358185788	1	\$4.84	\$4.85	19,820	\$5.09	\$25.00	-4.35%	10/26/21 at 11:28:44.990096160	\$4.89	10/27/21 at 09:31:07.981451822	\$4.99
10/27/21	15:51:41.855027429	100	\$4.85	\$4.86	64,048	\$4.77	\$6.25	-4.28%	10/27/21 at 14:38:05.912946665	\$5.02	10/27/21 at 15:52:00.653639015	\$4.86
10/27/21	15:51:41.855027429	10	\$4.85	\$4.86	64,048	\$4.77	\$6.25	-4.28%	10/27/21 at 14:38:05.912946665	\$5.02	10/27/21 at 15:52:00.653639015	\$4.86



Date	Executing Purchase			Best Offer (NBBO Quote)	Baiting Orders			Price Decline <sup>1</sup>	Prior Sale by Defendant <sup>2</sup>		Next Sale by Defendant <sup>2</sup>	
	Time	Volume	Price <sup>3</sup>		Volume <sup>4</sup>	Min. Price <sup>5</sup>	Max. Price <sup>5</sup>		Time	Price	Time	Price
10/27/21	15:51:41.855027429	25	\$4.85	\$4.86	64,048	\$4.77	\$6.25	-4.28%	10/27/21 at 14:38:05.912946665	\$5.02	10/27/21 at 15:52:00.653639015	\$4.86
10/27/21	15:51:41.855027429	137	\$4.85	\$4.86	64,048	\$4.77	\$6.25	-4.28%	10/27/21 at 14:38:05.912946665	\$5.02	10/27/21 at 15:52:00.653639015	\$4.86
10/27/21	15:51:43.081384048	300	\$4.85	\$4.86	64,048	\$4.77	\$6.25	-4.28%	10/27/21 at 14:38:05.912946665	\$5.02	10/27/21 at 15:52:00.653639015	\$4.86
10/27/21	15:51:43.083119342	89	\$4.85	\$4.86	64,048	\$4.77	\$6.25	-4.28%	10/27/21 at 14:38:05.912946665	\$5.02	10/27/21 at 15:52:00.653639015	\$4.86
10/27/21	15:51:43.373396696	474	\$4.85	\$4.86	64,048	\$4.77	\$6.25	-4.28%	10/27/21 at 14:38:05.912946665	\$5.02	10/27/21 at 15:52:00.653639015	\$4.86
10/27/21	15:51:43.373396696	26	\$4.85	\$4.86	64,048	\$4.77	\$6.25	-4.28%	10/27/21 at 14:38:05.912946665	\$5.02	10/27/21 at 15:52:00.653639015	\$4.86
10/27/21	15:51:44.802113180	274	\$4.85	\$4.86	64,048	\$4.77	\$6.25	-4.28%	10/27/21 at 14:38:05.912946665	\$5.02	10/27/21 at 15:52:00.653639015	\$4.86
10/27/21	15:54:30.531460178	100	\$4.71	\$4.72	130,936	\$4.68	\$10.00	-4.15%	10/27/21 at 15:54:14.091591872	\$4.72	10/27/21 at 15:57:24.407392221	\$4.78
10/28/21	09:30:03.062060291	21	\$4.89	\$4.90	743	\$4.95	\$300.00	-6.05%	10/27/21 at 14:38:05.912946665	\$5.02	10/28/21 at 09:30:03.631797430	\$4.91
10/28/21	09:30:03.062107604	4	\$4.89	\$4.90	743	\$4.95	\$300.00	-6.05%	10/27/21 at 14:38:05.912946665	\$5.02	10/28/21 at 09:30:03.631797430	\$4.91
10/28/21	09:30:06.494679430	6	\$4.88	\$4.90	1,898	\$4.95	\$300.00	-6.05%	10/28/21 at 09:30:04.051764566	\$4.92	11/02/21 at 15:27:32.014482723	\$5.04
10/28/21	09:30:06.494679430	2	\$4.88	\$4.90	1,898	\$4.95	\$300.00	-6.05%	10/28/21 at 09:30:04.051764566	\$4.92	11/02/21 at 15:27:32.014482723	\$5.04
10/28/21	09:30:42.041011505	1	\$4.87	\$4.88	111,761	\$4.95	\$300.00	-6.05%	10/28/21 at 09:30:04.051764566	\$4.92	11/02/21 at 15:27:32.014482723	\$5.04
10/28/21	09:30:42.686889852	400	\$4.86	\$4.88	119,648	\$4.95	\$300.00	-6.05%	10/28/21 at 09:30:04.051764566	\$4.92	11/02/21 at 15:27:32.014482723	\$5.04
10/28/21	09:30:44.295108927	100	\$4.85	\$4.87	131,818	\$4.95	\$300.00	-6.05%	10/28/21 at 09:30:04.051764566	\$4.92	11/02/21 at 15:27:32.014482723	\$5.04
10/28/21	09:30:44.295108927	250	\$4.85	\$4.87	131,818	\$4.95	\$300.00	-6.05%	10/28/21 at 09:30:04.051764566	\$4.92	11/02/21 at 15:27:32.014482723	\$5.04
10/28/21	09:30:50.697796234	2	\$4.84	\$4.86	274,859	\$4.95	\$300.00	-6.05%	10/28/21 at 09:30:04.051764566	\$4.92	11/02/21 at 15:27:32.014482723	\$5.04
10/28/21	09:30:50.697796234	3	\$4.84	\$4.86	274,859	\$4.95	\$300.00	-6.05%	10/28/21 at 09:30:04.051764566	\$4.92	11/02/21 at 15:27:32.014482723	\$5.04
10/28/21	09:30:52.434305779	20	\$4.83	\$4.86	1,228,328	\$4.95	\$300.00	-6.05%	10/28/21 at 09:30:04.051764566	\$4.92	11/02/21 at 15:27:32.014482723	\$5.04

Date	Executing Purchase			Best Offer (NBBO Quote)	Baiting Orders			Price Decline <sup>1</sup>	Prior Sale by Defendant <sup>2</sup>		Next Sale by Defendant <sup>2</sup>	
	Time	Volume	Price <sup>3</sup>		Volume <sup>4</sup>	Min. Price <sup>5</sup>	Max. Price <sup>5</sup>		Time	Price	Time	Price
10/28/21	09:30:52.453692500	14	\$4.80	\$4.81	1,228,588	\$4.95	\$300.00	-6.05%	10/28/21 at 09:30:04.051764566	\$4.92	11/02/21 at 15:27:32.014482723	\$5.04
10/28/21	09:30:52.454912370	1	\$4.80	\$4.81	1,228,588	\$4.95	\$300.00	-6.05%	10/28/21 at 09:30:04.051764566	\$4.92	11/02/21 at 15:27:32.014482723	\$5.04
10/28/21	09:30:52.656608175	19	\$4.80	\$4.81	1,239,752	\$4.95	\$300.00	-6.05%	10/28/21 at 09:30:04.051764566	\$4.92	11/02/21 at 15:27:32.014482723	\$5.04
10/28/21	09:30:52.656608175	10	\$4.80	\$4.81	1,239,752	\$4.95	\$300.00	-6.05%	10/28/21 at 09:30:04.051764566	\$4.92	11/02/21 at 15:27:32.014482723	\$5.04
10/28/21	09:30:52.656608175	135	\$4.80	\$4.81	1,239,752	\$4.95	\$300.00	-6.05%	10/28/21 at 09:30:04.051764566	\$4.92	11/02/21 at 15:27:32.014482723	\$5.04
10/28/21	09:30:52.656608175	5	\$4.80	\$4.81	1,239,752	\$4.95	\$300.00	-6.05%	10/28/21 at 09:30:04.051764566	\$4.92	11/02/21 at 15:27:32.014482723	\$5.04
10/28/21	09:30:52.656608175	50	\$4.80	\$4.81	1,239,752	\$4.95	\$300.00	-6.05%	10/28/21 at 09:30:04.051764566	\$4.92	11/02/21 at 15:27:32.014482723	\$5.04
10/28/21	09:30:55.625047794	724	\$4.80	\$4.82	1,320,403	\$4.95	\$300.00	-6.05%	10/28/21 at 09:30:04.051764566	\$4.92	11/02/21 at 15:27:32.014482723	\$5.04
10/28/21	09:30:55.625294768	90	\$4.80	\$4.81	1,320,403	\$4.95	\$300.00	-6.05%	10/28/21 at 09:30:04.051764566	\$4.92	11/02/21 at 15:27:32.014482723	\$5.04
10/28/21	09:30:55.625347231	179	\$4.80	\$4.81	1,320,403	\$4.95	\$300.00	-6.05%	10/28/21 at 09:30:04.051764566	\$4.92	11/02/21 at 15:27:32.014482723	\$5.04
10/28/21	09:30:55.625662121	600	\$4.80	\$4.81	1,320,403	\$4.95	\$300.00	-6.05%	10/28/21 at 09:30:04.051764566	\$4.92	11/02/21 at 15:27:32.014482723	\$5.04
10/28/21	09:30:55.625691170	75	\$4.80	\$4.81	1,320,403	\$4.95	\$300.00	-6.05%	10/28/21 at 09:30:04.051764566	\$4.92	11/02/21 at 15:27:32.014482723	\$5.04
10/28/21	09:30:55.625730333	415	\$4.80	\$4.81	1,320,403	\$4.95	\$300.00	-6.05%	10/28/21 at 09:30:04.051764566	\$4.92	11/02/21 at 15:27:32.014482723	\$5.04
10/28/21	09:31:00.724900255	200	\$4.78	\$4.80	1,320,403	\$4.95	\$300.00	-6.05%	10/28/21 at 09:30:04.051764566	\$4.92	10/28/21 at 15:55:01.227506971	\$4.79
10/28/21	09:31:00.724900255	1,000	\$4.78	\$4.80	1,320,403	\$4.95	\$300.00	-6.05%	10/28/21 at 09:30:04.051764566	\$4.92	10/28/21 at 15:55:01.227506971	\$4.79
10/28/21	09:31:00.724900255	1	\$4.78	\$4.80	1,320,403	\$4.95	\$300.00	-6.05%	10/28/21 at 09:30:04.051764566	\$4.92	10/28/21 at 15:55:01.227506971	\$4.79
10/28/21	09:31:00.724900255	50	\$4.78	\$4.80	1,320,403	\$4.95	\$300.00	-6.05%	10/28/21 at 09:30:04.051764566	\$4.92	10/28/21 at 15:55:01.227506971	\$4.79
10/28/21	09:31:00.724900255	100	\$4.78	\$4.80	1,320,403	\$4.95	\$300.00	-6.05%	10/28/21 at 09:30:04.051764566	\$4.92	10/28/21 at 15:55:01.227506971	\$4.79
10/28/21	09:31:00.724900255	1	\$4.78	\$4.80	1,320,403	\$4.95	\$300.00	-6.05%	10/28/21 at 09:30:04.051764566	\$4.92	10/28/21 at 15:55:01.227506971	\$4.79

Date	Executing Purchase			Best Offer (NBBO Quote)	Baiting Orders			Price Decline <sup>1</sup>	Prior Sale by Defendant <sup>2</sup>		Next Sale by Defendant <sup>2</sup>	
	Time	Volume	Price <sup>3</sup>		Volume <sup>4</sup>	Min. Price <sup>5</sup>	Max. Price <sup>5</sup>		Time	Price	Time	Price
10/28/21	09:31:00.725291989	100	\$4.77	\$4.78	1,320,403	\$4.95	\$300.00	-6.05%	10/28/21 at 09:30:04.051764566	\$4.92	10/28/21 at 15:55:01.227506971	\$4.79
10/28/21	09:31:00.727526297	20	\$4.76	\$4.77	1,320,303	\$4.95	\$300.00	-6.05%	10/28/21 at 09:30:04.051764566	\$4.92	10/28/21 at 15:55:01.227506971	\$4.79
10/28/21	09:31:00.727526297	8	\$4.76	\$4.77	1,320,303	\$4.95	\$300.00	-6.05%	10/28/21 at 09:30:04.051764566	\$4.92	10/28/21 at 15:55:01.227506971	\$4.79
10/28/21	09:31:00.727526297	5	\$4.76	\$4.77	1,320,303	\$4.95	\$300.00	-6.05%	10/28/21 at 09:30:04.051764566	\$4.92	10/28/21 at 15:55:01.227506971	\$4.79
10/28/21	09:31:20.050769018	250	\$4.75	\$4.76	1,320,303	\$4.95	\$300.00	-6.05%	10/28/21 at 09:30:04.051764566	\$4.92	10/28/21 at 15:55:00.042612693	\$4.76
10/28/21	09:31:20.050769018	73	\$4.75	\$4.76	1,320,303	\$4.95	\$300.00	-6.05%	10/28/21 at 09:30:04.051764566	\$4.92	10/28/21 at 15:55:00.042612693	\$4.76
10/28/21	09:31:27.648220245	12	\$4.71	\$4.72	1,320,303	\$4.95	\$300.00	-6.05%	10/28/21 at 09:30:04.051764566	\$4.92	10/28/21 at 15:50:35.082173595	\$4.72
10/28/21	09:31:29.737682494	100	\$4.70	\$4.72	1,320,303	\$4.95	\$300.00	-6.05%	10/28/21 at 09:30:04.051764566	\$4.92	10/28/21 at 15:50:35.082173595	\$4.72
10/28/21	09:31:36.463018163	29	\$4.66	\$4.67	1,320,203	\$4.95	\$300.00	-6.05%	10/28/21 at 09:30:04.051764566	\$4.92	10/28/21 at 15:50:35.082173595	\$4.72
10/28/21	09:31:36.463018163	82	\$4.66	\$4.67	1,320,203	\$4.95	\$300.00	-6.05%	10/28/21 at 09:30:04.051764566	\$4.92	10/28/21 at 15:50:35.082173595	\$4.72
10/28/21	09:31:36.463723396	118	\$4.66	\$4.67	1,320,203	\$4.95	\$300.00	-6.05%	10/28/21 at 09:30:04.051764566	\$4.92	10/28/21 at 15:50:35.082173595	\$4.72
10/29/21	09:30:12.384797531	5	\$4.56	\$4.58	3,505	\$4.62	\$6.23	-1.95%	10/28/21 at 16:00:00.543598501	\$4.79	10/29/21 at 09:31:02.956884148	\$4.60
10/29/21	09:30:12.384797531	166	\$4.56	\$4.58	3,505	\$4.62	\$6.23	-1.95%	10/28/21 at 16:00:00.543598501	\$4.79	10/29/21 at 09:31:02.956884148	\$4.60
10/29/21	09:30:12.384824031	109	\$4.56	\$4.57	3,505	\$4.62	\$6.23	-1.95%	10/28/21 at 16:00:00.543598501	\$4.79	10/29/21 at 09:31:02.956884148	\$4.60
10/29/21	09:30:13.350300897	5	\$4.55	\$4.57	4,505	\$4.62	\$6.23	-1.95%	10/28/21 at 16:00:00.543598501	\$4.79	10/29/21 at 09:31:02.956884148	\$4.60
10/29/21	09:30:13.350300897	50	\$4.55	\$4.57	4,505	\$4.62	\$6.23	-1.95%	10/28/21 at 16:00:00.543598501	\$4.79	10/29/21 at 09:31:02.956884148	\$4.60
10/29/21	09:30:13.350300897	55	\$4.55	\$4.57	4,505	\$4.62	\$6.23	-1.95%	10/28/21 at 16:00:00.543598501	\$4.79	10/29/21 at 09:31:02.956884148	\$4.60
10/29/21	09:30:13.590893876	2	\$4.54	\$4.56	4,505	\$4.62	\$6.23	-1.95%	10/28/21 at 16:00:00.543598501	\$4.79	10/29/21 at 09:31:02.956884148	\$4.60
10/29/21	09:30:13.590893876	1	\$4.54	\$4.56	4,505	\$4.62	\$6.23	-1.95%	10/28/21 at 16:00:00.543598501	\$4.79	10/29/21 at 09:31:02.956884148	\$4.60

Date	Executing Purchase			Best Offer (NBBO Quote)	Baiting Orders			Price Decline <sup>1</sup>	Prior Sale by Defendant <sup>2</sup>		Next Sale by Defendant <sup>2</sup>	
	Time	Volume	Price <sup>3</sup>		Volume <sup>4</sup>	Min. Price <sup>5</sup>	Max. Price <sup>5</sup>		Time	Price	Time	Price
10/29/21	09:33:06.580061457	35	\$4.52	\$4.54	100	\$4.70	\$500.00	-3.68%	10/29/21 at 09:31:02.956884148	\$4.60	11/02/21 at 14:55:33.616346011	\$4.62
10/29/21	09:33:06.580061457	500	\$4.52	\$4.54	100	\$4.70	\$500.00	-3.68%	10/29/21 at 09:31:02.956884148	\$4.60	11/02/21 at 14:55:33.616346011	\$4.62
10/29/21	09:33:06.580061457	128	\$4.52	\$4.54	100	\$4.70	\$500.00	-3.68%	10/29/21 at 09:31:02.956884148	\$4.60	11/02/21 at 14:55:33.616346011	\$4.62
10/29/21	09:33:06.580481358	172	\$4.52	\$4.53	100	\$4.70	\$500.00	-3.68%	10/29/21 at 09:31:02.956884148	\$4.60	11/02/21 at 14:55:33.616346011	\$4.62
10/29/21	09:33:06.580481358	3	\$4.52	\$4.53	100	\$4.70	\$500.00	-3.68%	10/29/21 at 09:31:02.956884148	\$4.60	11/02/21 at 14:55:33.616346011	\$4.62
10/29/21	09:33:06.580481358	300	\$4.52	\$4.53	100	\$4.70	\$500.00	-3.68%	10/29/21 at 09:31:02.956884148	\$4.60	11/02/21 at 14:55:33.616346011	\$4.62
10/29/21	09:33:14.028348283	3,000	\$4.51	\$4.52	100	\$4.70	\$500.00	-3.47%	10/29/21 at 09:31:02.956884148	\$4.60	11/02/21 at 14:55:33.616346011	\$4.62
10/29/21	09:33:16.092335169	34	\$4.49	\$4.51	100	\$4.70	\$500.00	-3.47%	10/29/21 at 09:31:02.956884148	\$4.60	11/02/21 at 14:55:33.616346011	\$4.62
10/29/21	09:33:16.092335169	10	\$4.50	\$4.51	100	\$4.70	\$500.00	-3.47%	10/29/21 at 09:31:02.956884148	\$4.60	11/02/21 at 14:55:33.616346011	\$4.62
10/29/21	09:33:16.092335169	1,344	\$4.50	\$4.51	100	\$4.70	\$500.00	-3.47%	10/29/21 at 09:31:02.956884148	\$4.60	11/02/21 at 14:55:33.616346011	\$4.62
11/2/21	09:32:52.910629456	10	\$3.55	\$3.56	132	\$4.20	\$4.56	-5.71%	11/02/21 at 09:30:42.262269602	\$3.65	11/02/21 at 14:55:33.616346011	\$4.62
11/2/21	09:32:52.910637131	90	\$3.55	\$3.56	132	\$4.20	\$4.56	-5.71%	11/02/21 at 09:30:42.262269602	\$3.65	11/02/21 at 14:55:33.616346011	\$4.62
11/2/21	09:32:56.396054365	4	\$3.53	\$3.54	100	\$4.20	\$4.56	-5.71%	11/02/21 at 09:30:42.262269602	\$3.65	11/02/21 at 14:55:33.616346011	\$4.62
11/2/21	09:40:07.604982281	100	\$3.45	\$3.46	200	\$3.75	\$500.00	-1.71%	11/02/21 at 09:30:42.262269602	\$3.65	11/02/21 at 14:55:33.616346011	\$4.62
11/2/21	15:51:38.546244458	250	\$4.76	\$4.77	16,778	\$4.70	\$9.99	-8.71%	11/02/21 at 15:38:59.295189116	\$5.03	11/03/21 at 11:09:46.050960249	\$4.87
11/2/21	15:51:56.769880385	300	\$4.71	\$4.72	21,243	\$4.50	\$9.99	-10.17%	11/02/21 at 15:51:55.876309116	\$4.72	11/03/21 at 11:09:46.050960249	\$4.87
11/2/21	15:55:17.289151758	20	\$4.52	\$4.53	6,238	\$4.50	\$6.00	-7.08%	11/02/21 at 15:54:51.918770303	\$4.53	11/02/21 at 15:58:26.511756097	\$4.53
11/2/21	15:55:17.289151758	1,200	\$4.52	\$4.53	6,238	\$4.50	\$6.00	-7.08%	11/02/21 at 15:54:51.918770303	\$4.53	11/02/21 at 15:58:26.511756097	\$4.53
11/2/21	15:55:17.289151758	500	\$4.52	\$4.53	6,238	\$4.50	\$6.00	-7.08%	11/02/21 at 15:54:51.918770303	\$4.53	11/02/21 at 15:58:26.511756097	\$4.53

Date	Executing Purchase			Best Offer (NBBO Quote)	Baiting Orders			Price Decline <sup>1</sup>	Prior Sale by Defendant <sup>2</sup>		Next Sale by Defendant <sup>2</sup>	
	Time	Volume	Price <sup>3</sup>		Volume <sup>4</sup>	Min. Price <sup>5</sup>	Max. Price <sup>5</sup>		Time	Price	Time	Price
11/2/21	15:55:17.289151758	118	\$4.52	\$4.53	6,238	\$4.50	\$6.00	-7.08%	11/02/21 at 15:54:51.918770303	\$4.53	11/02/21 at 15:58:26.511756097	\$4.53
11/2/21	15:55:17.292164498	12	\$4.50	\$4.51	6,238	\$4.50	\$6.00	-7.08%	11/02/21 at 15:54:51.918770303	\$4.53	11/02/21 at 15:56:54.038337177	\$4.52
11/3/21	09:30:01.805217912	5	\$4.39	\$4.42	201	\$4.50	\$8.50	-2.02%	11/02/21 at 15:59:48.113637506	\$4.56	11/03/21 at 09:37:16.873568621	\$4.69
11/3/21	09:30:01.805217912	100	\$4.39	\$4.42	201	\$4.50	\$8.50	-2.02%	11/02/21 at 15:59:48.113637506	\$4.56	11/03/21 at 09:37:16.873568621	\$4.69
11/3/21	09:30:01.805217912	715	\$4.39	\$4.42	201	\$4.50	\$8.50	-2.02%	11/02/21 at 15:59:48.113637506	\$4.56	11/03/21 at 09:37:16.873568621	\$4.69
11/4/21	09:30:48.876379601	50	\$4.30	\$4.31	287	\$4.38	\$5.58	-2.51%	11/04/21 at 09:30:00.558567749	\$4.37	11/04/21 at 09:31:53.068101126	\$4.40
11/4/21	09:30:48.876379601	20	\$4.30	\$4.31	287	\$4.38	\$5.58	-2.51%	11/04/21 at 09:30:00.558567749	\$4.37	11/04/21 at 09:31:53.068101126	\$4.40
11/5/21	15:51:16.876218021	500	\$4.21	\$4.22	5,000	\$4.31	\$4.31	-1.88%	11/05/21 at 15:50:42.309025171	\$4.24	11/05/21 at 15:59:56.012122109	\$4.22
11/5/21	15:51:16.876218021	1	\$4.21	\$4.22	5,000	\$4.31	\$4.31	-1.88%	11/05/21 at 15:50:42.309025171	\$4.24	11/05/21 at 15:59:56.012122109	\$4.22
11/5/21	15:51:19.136034066	1	\$4.20	\$4.21	5,000	\$4.31	\$4.31	-1.88%	11/05/21 at 15:50:42.309025171	\$4.24	11/05/21 at 15:54:30.439184155	\$4.21
11/8/21	09:31:10.819030751	28	\$4.11	\$4.12	1,312,327	\$4.16	\$500.00	-2.16%	11/05/21 at 16:00:00.418428151	\$4.22	11/08/21 at 15:54:50.015481630	\$4.30
11/8/21	09:31:10.819250761	440	\$4.10	\$4.11	1,312,327	\$4.16	\$500.00	-2.16%	11/05/21 at 16:00:00.418428151	\$4.22	11/08/21 at 15:54:50.015481630	\$4.30
11/17/21	09:32:38.409537301	200	\$3.85	\$3.86	8,130	\$4.99	\$16.84	-2.05%	11/16/21 at 15:51:34.644524606	\$3.92	11/19/21 at 09:32:56.787978304	\$3.99
11/17/21	09:32:38.409537301	1,000	\$3.85	\$3.86	8,130	\$4.99	\$16.84	-2.05%	11/16/21 at 15:51:34.644524606	\$3.92	11/19/21 at 09:32:56.787978304	\$3.99
11/22/21	09:31:10.620460720	30	\$3.59	\$3.60	101	\$3.80	\$4.64	-3.01%	11/22/21 at 09:30:03.037417786	\$3.62	12/02/21 at 09:30:04.105999799	\$3.75
11/22/21	09:33:09.127809696	50	\$3.55	\$3.56	1	\$3.80	\$3.80	-1.67%	11/22/21 at 09:30:03.037417786	\$3.62	12/02/21 at 09:30:04.105999799	\$3.75
11/22/21	09:33:09.127809696	70	\$3.55	\$3.56	1	\$3.80	\$3.80	-1.67%	11/22/21 at 09:30:03.037417786	\$3.62	12/02/21 at 09:30:04.105999799	\$3.75
11/23/21	09:32:47.025263545	200	\$3.33	\$3.34	100	\$4.32	\$4.32	-3.22%	11/23/21 at 09:30:48.801547329	\$3.40	11/29/21 at 09:30:51.768021637	\$3.35
12/1/21	15:52:34.297774251	700	\$3.07	\$3.08	1,100	\$3.11	\$10.99	-7.58%	12/01/21 at 15:52:22.710082486	\$3.09	12/01/21 at 15:52:58.137594175	\$3.10

Date	Executing Purchase			Best Offer (NBBO Quote)	Baiting Orders			Price Decline <sup>1</sup>	Prior Sale by Defendant <sup>2</sup>		Next Sale by Defendant <sup>2</sup>	
	Time	Volume	Price <sup>3</sup>		Volume <sup>4</sup>	Min. Price <sup>5</sup>	Max. Price <sup>5</sup>		Time	Price	Time	Price
12/2/21	09:30:02.799181020	30	\$3.70	\$3.72	6,755	\$3.75	\$17.80	-6.58%	11/19/21 at 09:32:58.647755618	\$4.00	12/02/21 at 09:30:04.105999799	\$3.75
12/2/21	09:30:10.557479002	752	\$3.70	\$3.71	7,780	\$3.75	\$17.80	-6.58%	12/02/21 at 09:30:04.107673723	\$3.75	12/08/21 at 15:50:38.359910355	\$3.88
12/2/21	09:30:10.557482267	1,200	\$3.70	\$3.71	7,780	\$3.75	\$17.80	-6.58%	12/02/21 at 09:30:04.107673723	\$3.75	12/08/21 at 15:50:38.359910355	\$3.88
12/2/21	09:30:10.557482745	1,000	\$3.70	\$3.71	7,780	\$3.75	\$17.80	-6.58%	12/02/21 at 09:30:04.107673723	\$3.75	12/08/21 at 15:50:38.359910355	\$3.88
12/2/21	09:30:10.557492700	2,048	\$3.70	\$3.71	7,780	\$3.75	\$17.80	-6.58%	12/02/21 at 09:30:04.107673723	\$3.75	12/08/21 at 15:50:38.359910355	\$3.88
12/2/21	09:30:10.557535756	4	\$3.69	\$3.71	7,780	\$3.75	\$17.80	-6.58%	12/02/21 at 09:30:04.107673723	\$3.75	12/08/21 at 15:50:38.359910355	\$3.88
12/2/21	09:30:21.497242100	400	\$3.66	\$3.67	11,408	\$3.75	\$17.80	-6.58%	12/02/21 at 09:30:04.107673723	\$3.75	12/08/21 at 15:50:38.359910355	\$3.88
12/2/21	09:30:21.497986539	2,739	\$3.65	\$3.66	11,408	\$3.75	\$17.80	-6.58%	12/02/21 at 09:30:04.107673723	\$3.75	12/08/21 at 15:50:38.359910355	\$3.88
12/2/21	09:30:21.498083649	8	\$3.65	\$3.66	11,408	\$3.75	\$17.80	-6.58%	12/02/21 at 09:30:04.107673723	\$3.75	12/08/21 at 15:50:38.359910355	\$3.88
12/2/21	09:30:45.869690676	3,639	\$3.64	\$3.65	79,450	\$3.75	\$17.80	-6.58%	12/02/21 at 09:30:04.107673723	\$3.75	12/08/21 at 15:50:38.359910355	\$3.88
12/2/21	09:30:45.869718796	161	\$3.64	\$3.65	79,450	\$3.75	\$17.80	-6.58%	12/02/21 at 09:30:04.107673723	\$3.75	12/08/21 at 15:50:38.359910355	\$3.88
12/2/21	09:30:51.184740933	100	\$3.60	\$3.61	84,577	\$3.75	\$17.80	-6.58%	12/02/21 at 09:30:04.107673723	\$3.75	12/08/21 at 15:50:38.359910355	\$3.88
12/2/21	15:52:32.466585081	18	\$3.49	\$3.50	1,049	\$3.48	\$3.75	-1.71%	12/02/21 at 09:30:04.107673723	\$3.75	12/08/21 at 15:50:38.359910355	\$3.88
12/2/21	15:52:52.569313190	700	\$3.48	\$3.49	1,018	\$3.48	\$3.75	-1.71%	12/02/21 at 09:30:04.107673723	\$3.75	12/02/21 at 15:59:45.648612165	\$3.49
12/6/21	09:31:06.441098314	10	\$3.09	\$3.10	51,336	\$3.15	\$20.00	-2.22%	12/02/21 at 15:59:45.648612165	\$3.49	12/07/21 at 15:55:39.983263316	\$3.16
12/6/21	15:53:24.898717621	4,508	\$2.97	\$2.98	175	\$3.04	\$3.04	-1.00%	12/03/21 at 16:00:00.870351730	\$3.03	12/07/21 at 09:30:04.026034505	\$3.06
12/7/21	09:30:54.764954317	39	\$3.03	\$3.05	250	\$3.12	\$3.12	-1.63%	12/07/21 at 09:30:04.026158376	\$3.06	12/07/21 at 15:55:39.983263316	\$3.16
12/8/21	15:55:26.642163396	141	\$3.90	\$3.91	7,809	\$3.90	\$4.88	-2.62%	12/08/21 at 15:54:34.190048183	\$3.93	12/08/21 at 15:56:33.244678965	\$3.91
12/8/21	15:55:26.642176358	859	\$3.90	\$3.91	7,809	\$3.90	\$4.88	-2.62%	12/08/21 at 15:54:34.190048183	\$3.93	12/08/21 at 15:56:33.244678965	\$3.91

Date	Executing Purchase			Best Offer (NBBO Quote)	Baiting Orders			Price Decline <sup>1</sup>	Prior Sale by Defendant <sup>2</sup>		Next Sale by Defendant <sup>2</sup>	
	Time	Volume	Price <sup>3</sup>		Volume <sup>4</sup>	Min. Price <sup>5</sup>	Max. Price <sup>5</sup>		Time	Price	Time	Price
12/9/21	09:42:59.185038417	14	\$3.50	\$3.51	100	\$3.91	\$500.00	-1.97%	12/09/21 at 09:36:21.303402498	\$3.70	12/09/21 at 10:04:29.716230388	\$3.72
12/13/21	09:31:17.973147361	100	\$3.30	\$3.31	104,658	\$3.55	\$500.00	-3.87%	12/09/21 at 10:04:29.716235277	\$3.72	01/18/22 at 15:53:59.182435061	\$3.32
12/13/21	09:31:58.716682030	76	\$3.28	\$3.29	1,144,073	\$3.55	\$500.00	-3.87%	12/09/21 at 10:04:29.716235277	\$3.72	01/18/22 at 15:51:59.163337644	\$3.30
12/13/21	09:31:58.716863658	24	\$3.28	\$3.29	1,144,073	\$3.55	\$500.00	-3.87%	12/09/21 at 10:04:29.716235277	\$3.72	01/18/22 at 15:51:59.163337644	\$3.30
12/13/21	09:31:58.716863658	167	\$3.28	\$3.29	1,144,073	\$3.55	\$500.00	-3.87%	12/09/21 at 10:04:29.716235277	\$3.72	01/18/22 at 15:51:59.163337644	\$3.30
12/16/21	09:31:02.127642952	32	\$3.07	\$3.08	43,004	\$3.15	\$17.18	-1.94%	12/15/21 at 15:59:00.196754664	\$3.10	01/06/22 at 15:56:36.072792395	\$3.08
12/21/21	09:30:50.676381053	1	\$2.93	\$2.94	10,980	\$2.97	\$500.00	-2.36%	12/17/21 at 15:58:04.222478633	\$3.06	12/21/21 at 15:55:00.363711575	\$3.05
12/23/21	09:30:42.807125897	30	\$3.01	\$3.02	100	\$3.86	\$3.86	-1.98%	12/21/21 at 15:55:00.363711575	\$3.05	12/23/21 at 16:00:00.524048747	\$3.06
12/23/21	09:30:42.807125897	5,619	\$3.01	\$3.02	100	\$3.86	\$3.86	-1.98%	12/21/21 at 15:55:00.363711575	\$3.05	12/23/21 at 16:00:00.524048747	\$3.06
12/23/21	09:30:42.807165506	5,325	\$3.01	\$3.02	100	\$3.86	\$3.86	-1.98%	12/21/21 at 15:55:00.363711575	\$3.05	12/23/21 at 16:00:00.524048747	\$3.06
12/23/21	09:30:42.807180338	824	\$3.01	\$3.02	100	\$3.86	\$3.86	-1.98%	12/21/21 at 15:55:00.363711575	\$3.05	12/23/21 at 16:00:00.524048747	\$3.06
12/23/21	09:30:42.807257164	4,232	\$3.01	\$3.02	100	\$3.86	\$3.86	-1.98%	12/21/21 at 15:55:00.363711575	\$3.05	12/23/21 at 16:00:00.524048747	\$3.06
12/23/21	09:31:03.105205395	100	\$3.00	\$3.01	35,075	\$3.10	\$500.00	-1.98%	12/21/21 at 15:55:00.363711575	\$3.05	12/23/21 at 16:00:00.524048747	\$3.06
12/23/21	09:31:17.866138059	10	\$2.99	\$3.00	90,849	\$3.10	\$500.00	-1.98%	12/21/21 at 15:55:00.363711575	\$3.05	12/23/21 at 16:00:00.524048747	\$3.06
12/23/21	09:31:24.567916355	8	\$2.98	\$2.99	152,108	\$3.10	\$500.00	-1.98%	12/21/21 at 15:55:00.363711575	\$3.05	12/23/21 at 16:00:00.524048747	\$3.06
12/23/21	09:31:24.568177094	3,992	\$2.98	\$2.99	152,108	\$3.10	\$500.00	-1.98%	12/21/21 at 15:55:00.363711575	\$3.05	12/23/21 at 16:00:00.524048747	\$3.06
12/28/21	09:31:09.548196755	1	\$2.85	\$2.86	202	\$2.90	\$3.67	-2.08%	12/23/21 at 16:00:00.524048747	\$3.06	01/06/22 at 15:52:21.728153670	\$2.92
12/30/21	09:31:30.106568098	2	\$2.62	\$2.63	198,316	\$2.75	\$150.00	-2.62%	12/23/21 at 16:00:00.524048747	\$3.06	12/31/21 at 16:00:00.748308057	\$2.63
12/31/21	15:55:09.274569065	401	\$2.63	\$2.64	470	\$2.64	\$4.00	-0.76%	12/23/21 at 16:00:00.524048747	\$3.06	01/03/22 at 15:59:54.214452128	\$2.79



Date	Executing Purchase			Best Offer (NBBO Quote)	Baiting Orders			Price Decline <sup>1</sup>	Prior Sale by Defendant <sup>2</sup>		Next Sale by Defendant <sup>2</sup>	
	Time	Volume	Price <sup>3</sup>		Volume <sup>4</sup>	Min. Price <sup>5</sup>	Max. Price <sup>5</sup>		Time	Price	Time	Price
12/31/21	15:55:09.277391333	79	\$2.63	\$2.64	470	\$2.64	\$4.00	-0.76%	12/23/21 at 16:00:00.524048747	\$3.06	01/03/22 at 15:59:54.214452128	\$2.79
12/31/21	15:55:09.277391333	220	\$2.63	\$2.64	470	\$2.64	\$4.00	-0.76%	12/23/21 at 16:00:00.524048747	\$3.06	01/03/22 at 15:59:54.214452128	\$2.79
12/31/21	15:55:09.277861832	280	\$2.63	\$2.64	470	\$2.64	\$4.00	-0.76%	12/23/21 at 16:00:00.524048747	\$3.06	01/03/22 at 15:59:54.214452128	\$2.79
1/4/22	09:31:10.955760714	3	\$2.75	\$2.76	116,200	\$2.90	\$300.00	-2.53%	01/04/22 at 09:30:02.260542494	\$2.76	01/06/22 at 15:52:21.728153670	\$2.92
1/6/22	09:32:18.578553950	145	\$2.58	\$2.59	1,264	\$2.58	\$2.59	-1.15%	01/04/22 at 09:30:02.260542494	\$2.76	01/06/22 at 15:52:21.728153670	\$2.92
1/6/22	15:57:15.353069063	500	\$3.16	\$3.17	12,514	\$3.09	\$3.25	-6.29%	12/09/21 at 10:04:29.716235277	\$3.72	01/18/22 at 15:51:59.163337644	\$3.30
1/6/22	15:57:15.353069063	200	\$3.16	\$3.17	12,514	\$3.09	\$3.25	-6.29%	12/09/21 at 10:04:29.716235277	\$3.72	01/18/22 at 15:51:59.163337644	\$3.30
1/13/22	09:31:15.466319737	500	\$3.00	\$3.01	72,687	\$3.14	\$90.00	-4.21%	01/12/22 at 15:59:55.094205483	\$3.15	01/18/22 at 09:41:28.603122401	\$3.02
1/13/22	09:31:15.466319737	50	\$3.00	\$3.01	72,687	\$3.14	\$90.00	-4.21%	01/12/22 at 15:59:55.094205483	\$3.15	01/18/22 at 09:41:28.603122401	\$3.02
1/13/22	09:31:15.468344158	10	\$2.99	\$3.00	72,687	\$3.14	\$90.00	-4.21%	01/12/22 at 15:59:55.094205483	\$3.15	01/18/22 at 09:41:14.113803873	\$3.00
1/19/22	09:30:08.949038610	8	\$3.21	\$3.22	1,415	\$3.28	\$300.00	-4.65%	01/18/22 at 16:00:01.262187785	\$3.25	02/08/22 at 15:52:19.793948202	\$3.30
1/19/22	09:30:11.250732154	200	\$3.20	\$3.21	1,415	\$3.28	\$300.00	-4.65%	01/18/22 at 16:00:01.262187785	\$3.25	02/08/22 at 15:52:19.793948202	\$3.30
1/19/22	09:30:11.250732154	6	\$3.20	\$3.21	1,415	\$3.28	\$300.00	-4.65%	01/18/22 at 16:00:01.262187785	\$3.25	02/08/22 at 15:52:19.793948202	\$3.30
1/19/22	09:30:11.253827349	75	\$3.18	\$3.19	1,415	\$3.28	\$300.00	-4.65%	01/18/22 at 16:00:01.262187785	\$3.25	02/08/22 at 15:52:19.793948202	\$3.30
1/19/22	09:30:11.253827349	11	\$3.18	\$3.19	1,415	\$3.28	\$300.00	-4.65%	01/18/22 at 16:00:01.262187785	\$3.25	02/08/22 at 15:52:19.793948202	\$3.30
1/19/22	09:31:13.770778092	838	\$3.12	\$3.13	104,692	\$3.28	\$300.00	-4.64%	01/18/22 at 16:00:01.262187785	\$3.25	02/08/22 at 15:52:19.793948202	\$3.30
1/19/22	09:31:13.770808544	162	\$3.12	\$3.13	104,692	\$3.28	\$300.00	-4.64%	01/18/22 at 16:00:01.262187785	\$3.25	02/08/22 at 15:52:19.793948202	\$3.30
1/19/22	09:31:18.652291438	5	\$3.11	\$3.12	129,370	\$3.28	\$300.00	-4.64%	01/18/22 at 16:00:01.262187785	\$3.25	02/08/22 at 15:52:19.793948202	\$3.30
1/19/22	09:31:29.964231052	1,000	\$3.10	\$3.11	1,323,227	\$3.28	\$300.00	-4.64%	01/18/22 at 16:00:01.262187785	\$3.25	02/08/22 at 15:52:19.793948202	\$3.30



Date	Executing Purchase			Best Offer (NBBO Quote)	Baiting Orders			Price Decline <sup>1</sup>	Prior Sale by Defendant <sup>2</sup>		Next Sale by Defendant <sup>2</sup>	
	Time	Volume	Price <sup>3</sup>		Volume <sup>4</sup>	Min. Price <sup>5</sup>	Max. Price <sup>5</sup>		Time	Price	Time	Price
1/19/22	09:31:29.964231052	14	\$3.10	\$3.11	1,323,227	\$3.28	\$300.00	-4.64%	01/18/22 at 16:00:01.262187785	\$3.25	02/08/22 at 15:52:19.793948202	\$3.30
1/19/22	09:31:29.964231052	10	\$3.10	\$3.11	1,323,227	\$3.28	\$300.00	-4.64%	01/18/22 at 16:00:01.262187785	\$3.25	02/08/22 at 15:52:19.793948202	\$3.30
1/19/22	09:31:29.964231052	200	\$3.10	\$3.11	1,323,227	\$3.28	\$300.00	-4.64%	01/18/22 at 16:00:01.262187785	\$3.25	02/08/22 at 15:52:19.793948202	\$3.30
1/19/22	09:31:29.964231052	50	\$3.10	\$3.11	1,323,227	\$3.28	\$300.00	-4.64%	01/18/22 at 16:00:01.262187785	\$3.25	02/08/22 at 15:52:19.793948202	\$3.30
1/20/22	09:31:02.178067657	25	\$2.85	\$2.86	100	\$3.68	\$3.68	-2.77%	01/20/22 at 09:30:02.280643604	\$2.88	02/07/22 at 15:53:25.269983389	\$2.91
1/20/22	09:31:02.178067657	37	\$2.85	\$2.86	100	\$3.68	\$3.68	-2.77%	01/20/22 at 09:30:02.280643604	\$2.88	02/07/22 at 15:53:25.269983389	\$2.91
1/20/22	09:31:09.005061125	1	\$2.84	\$2.85	100	\$3.68	\$3.68	-2.77%	01/20/22 at 09:30:02.280643604	\$2.88	02/07/22 at 15:53:25.269983389	\$2.91
1/20/22	09:31:09.005061125	1	\$2.84	\$2.85	100	\$3.68	\$3.68	-2.77%	01/20/22 at 09:30:02.280643604	\$2.88	02/07/22 at 15:53:25.269983389	\$2.91
1/21/22	09:30:45.435033987	200	\$2.69	\$2.70	15,546	\$2.75	\$10.72	-3.26%	01/21/22 at 09:30:00.683733362	\$2.74	02/07/22 at 15:53:25.269983389	\$2.91
1/21/22	09:30:46.454058682	410	\$2.67	\$2.68	15,566	\$2.75	\$10.72	-3.26%	01/21/22 at 09:30:00.683733362	\$2.74	02/07/22 at 15:53:25.269983389	\$2.91
1/31/22	09:30:01.802463355	500	\$2.08	\$2.09	10	\$2.64	\$2.64	-1.90%	01/24/22 at 09:30:03.960603438	\$2.24	01/31/22 at 09:32:45.546605747	\$2.13
1/31/22	09:30:01.804405653	4	\$2.08	\$2.09	10	\$2.64	\$2.64	-1.90%	01/24/22 at 09:30:03.960603438	\$2.24	01/31/22 at 09:32:45.546605747	\$2.13
2/7/22	09:30:07.178094861	100	\$3.00	\$3.01	272	\$3.30	\$3.87	-3.95%	01/18/22 at 16:00:01.262187785	\$3.25	02/08/22 at 15:52:19.793948202	\$3.30
2/7/22	09:30:07.178094861	10	\$3.00	\$3.01	272	\$3.30	\$3.87	-3.95%	01/18/22 at 16:00:01.262187785	\$3.25	02/08/22 at 15:52:19.793948202	\$3.30
2/7/22	09:30:07.178094861	400	\$3.00	\$3.01	272	\$3.30	\$3.87	-3.95%	01/18/22 at 16:00:01.262187785	\$3.25	02/08/22 at 15:52:19.793948202	\$3.30
2/7/22	09:30:07.178094861	100	\$3.00	\$3.01	272	\$3.30	\$3.87	-3.95%	01/18/22 at 16:00:01.262187785	\$3.25	02/08/22 at 15:52:19.793948202	\$3.30
2/7/22	09:30:07.187663095	100	\$2.97	\$2.99	172	\$3.30	\$3.81	-3.95%	01/18/22 at 16:00:01.262187785	\$3.25	02/08/22 at 15:52:19.793948202	\$3.30
2/7/22	09:30:10.051357637	500	\$2.96	\$2.97	172	\$3.30	\$3.81	-3.95%	01/18/22 at 16:00:01.262187785	\$3.25	02/08/22 at 15:52:19.793948202	\$3.30
2/7/22	09:34:49.130798090	1,000	\$2.89	\$2.90	100	\$3.19	\$3.48	-3.03%	01/19/22 at 13:03:56.494743905	\$2.93	02/07/22 at 15:53:25.269983389	\$2.91

Date	Executing Purchase			Best Offer (NBBO Quote)	Baiting Orders			Price Decline <sup>1</sup>	Prior Sale by Defendant <sup>2</sup>		Next Sale by Defendant <sup>2</sup>	
	Time	Volume	Price <sup>3</sup>		Volume <sup>4</sup>	Min. Price <sup>5</sup>	Max. Price <sup>5</sup>		Time	Price	Time	Price
2/7/22	15:55:19.865963174	5,000	\$2.90	\$2.91	4,020	\$2.95	\$3.03	-2.05%	02/07/22 at 15:53:25.269983389	\$2.91	02/07/22 at 15:58:09.943743903	\$2.93
2/7/22	15:55:19.865963174	120	\$2.90	\$2.91	4,020	\$2.95	\$3.03	-2.05%	02/07/22 at 15:53:25.269983389	\$2.91	02/07/22 at 15:58:09.943743903	\$2.93
2/7/22	15:55:27.448856502	5	\$2.88	\$2.89	4,025	\$2.95	\$3.03	-2.05%	02/07/22 at 15:53:25.269983389	\$2.91	02/07/22 at 15:56:25.758002915	\$2.89
2/7/22	15:55:27.448883338	100	\$2.88	\$2.89	4,025	\$2.95	\$3.03	-2.05%	02/07/22 at 15:53:25.269983389	\$2.91	02/07/22 at 15:56:25.758002915	\$2.89
2/14/22	09:33:17.974079528	2,000	\$3.35	\$3.36	100	\$4.30	\$4.30	-2.65%	02/11/22 at 09:30:23.345663288	\$3.55	02/14/22 at 15:59:55.017105852	\$3.52
2/17/22	09:32:57.030918609	48	\$3.44	\$3.45	1,500	\$4.44	\$45.00	-3.13%	02/17/22 at 09:31:08.660198321	\$3.49	02/22/22 at 09:30:04.532961418	\$3.62
2/18/22	09:30:08.423635329	217	\$3.30	\$3.31	95	\$3.65	\$3.65	-2.06%	02/17/22 at 09:31:08.660198321	\$3.49	02/22/22 at 09:30:04.532961418	\$3.62
2/18/22	09:41:30.286656719	6	\$3.25	\$3.26	100	\$3.44	\$5,555.00	-3.29%	02/17/22 at 09:31:08.660198321	\$3.49	02/22/22 at 09:30:04.532961418	\$3.62
2/23/22	09:31:58.722004437	10,340	\$3.15	\$3.16	100	\$4.07	\$4.07	-2.80%	02/22/22 at 15:59:17.015085036	\$3.29		
2/23/22	09:31:58.722147788	100	\$3.15	\$3.16	100	\$4.07	\$4.07	-2.80%	02/22/22 at 15:59:17.015085036	\$3.29		
2/23/22	09:31:58.722184743	1,900	\$3.15	\$3.16	100	\$4.07	\$4.07	-2.80%	02/22/22 at 15:59:17.015085036	\$3.29		
2/23/22	09:31:58.722312978	12,380	\$3.15	\$3.16	100	\$4.07	\$4.07	-2.80%	02/22/22 at 15:59:17.015085036	\$3.29		
2/23/22	09:31:58.723032341	500	\$3.14	\$3.15	100	\$4.07	\$4.07	-2.80%	02/22/22 at 15:59:17.015085036	\$3.29		
3/8/22	09:30:16.800512170	1,046	\$2.27	\$2.29	27,121	\$2.32	\$500.00	-3.05%	03/07/22 at 09:38:10.247882270	\$2.53	03/09/22 at 09:35:42.285732234	\$2.43
3/8/22	09:31:16.388224995	200	\$2.26	\$2.27	137,742	\$2.32	\$500.00	-3.28%	03/07/22 at 09:38:10.247882270	\$2.53	03/09/22 at 09:35:42.285732234	\$2.43
3/8/22	09:31:16.388224995	98	\$2.26	\$2.27	137,742	\$2.32	\$500.00	-3.28%	03/07/22 at 09:38:10.247882270	\$2.53	03/09/22 at 09:35:42.285732234	\$2.43
3/21/22	09:30:05.863558543	100	\$2.73	\$2.74	301	\$2.77	\$4.26	-1.82%	03/04/22 at 09:35:46.737983828	\$2.75	03/22/22 at 15:58:48.770945146	\$2.76
3/21/22	09:30:05.863558543	10	\$2.73	\$2.74	301	\$2.77	\$4.26	-1.82%	03/04/22 at 09:35:46.737983828	\$2.75	03/22/22 at 15:58:48.770945146	\$2.76
4/12/22	09:30:09.485273493	220	\$2.20	\$2.21	100	\$2.86	\$2.86	-2.54%	04/07/22 at 09:35:04.744613211	\$2.40	04/13/22 at 09:30:00.608535125	\$2.24

Date	Executing Purchase			Best Offer (NBBO Quote)	Baiting Orders			Price Decline <sup>1</sup>	Prior Sale by Defendant <sup>2</sup>		Next Sale by Defendant <sup>2</sup>	
	Time	Volume	Price <sup>3</sup>		Volume <sup>4</sup>	Min. Price <sup>5</sup>	Max. Price <sup>5</sup>		Time	Price	Time	Price
4/20/22	09:31:57.491525302	2,000	\$2.20	\$2.21	100	\$2.84	\$2.84	-2.70%	04/19/22 at 15:50:26.385195743	\$2.21		
5/6/22	09:30:00.869117399	100	\$1.94	\$1.95	7	\$2.45	\$2.49	-2.56%	05/03/22 at 16:00:00.638020077	\$2.08		
5/6/22	09:30:03.936499283	100	\$1.94	\$1.95	126	\$2.45	\$2.49	-2.56%	05/03/22 at 16:00:00.638020077	\$2.08		
5/11/22	15:51:19.322963262	502	\$1.36	\$1.37	100	\$1.77	\$1.77	-2.80%	05/11/22 at 09:31:33.138651123	\$1.52	05/12/22 at 15:54:22.010821123	\$1.48
5/24/22	09:30:00.945602853	5	\$1.44	\$1.45	100	\$1.85	\$1.85	-2.78%	05/23/22 at 15:59:38.125219787	\$1.47	05/31/22 at 09:30:23.871935532	\$1.45
5/24/22	09:30:00.945607762	3	\$1.44	\$1.45	100	\$1.85	\$1.85	-2.78%	05/23/22 at 15:59:38.125219787	\$1.47	05/31/22 at 09:30:23.871935532	\$1.45
5/24/22	09:30:00.945641638	1,634	\$1.44	\$1.45	100	\$1.85	\$1.85	-2.78%	05/23/22 at 15:59:38.125219787	\$1.47	05/31/22 at 09:30:23.871935532	\$1.45
5/24/22	09:30:00.945646011	1	\$1.44	\$1.45	100	\$1.85	\$1.85	-2.78%	05/23/22 at 15:59:38.125219787	\$1.47	05/31/22 at 09:30:23.871935532	\$1.45
5/24/22	09:30:01.064907553	2,134	\$1.44	\$1.45	100	\$1.85	\$1.85	-2.78%	05/23/22 at 15:59:38.125219787	\$1.47	05/31/22 at 09:30:23.871935532	\$1.45
7/13/22	09:30:00.139278917	1	\$1.28	\$1.29	15	\$1.37	\$450.00	-1.56%	07/11/22 at 16:00:01.254609344	\$1.38	07/13/22 at 15:58:53.163769179	\$1.30
7/13/22	09:30:00.212950299	85	\$1.28	\$1.29	250	\$1.37	\$450.00	-1.56%	07/11/22 at 16:00:01.254609344	\$1.38	07/13/22 at 15:58:53.163769179	\$1.30
7/26/22	09:32:32.780135111	25	\$1.51	\$1.52	200	\$1.92	\$1.94	-2.95%	07/21/22 at 15:52:08.135159994	\$1.75	08/04/22 at 09:36:47.982957916	\$1.53
8/25/22	09:30:22.649071339	19	\$1.38	\$1.39	4,846	\$1.45	\$450.00	-2.50%	08/08/22 at 09:30:00.585983739	\$1.77	09/08/22 at 15:59:56.379166024	\$1.39
9/21/22	09:30:59.231138925	1,500	\$1.52	\$1.53	200	\$1.94	\$1.97	-5.19%	09/16/22 at 15:54:19.756678683	\$1.85	11/07/22 at 15:55:40.434533727	\$1.63
9/21/22	09:31:52.609081845	1,000	\$1.50	\$1.51	200	\$1.90	\$1.94	-5.84%	09/16/22 at 15:54:19.756678683	\$1.85	11/07/22 at 15:55:40.434533727	\$1.63
9/21/22	09:32:37.836636246	590	\$1.47	\$1.48	100	\$1.90	\$1.90	-5.23%	09/16/22 at 15:54:19.756678683	\$1.85	11/07/22 at 15:55:40.434533727	\$1.63
9/21/22	09:32:41.665601200	410	\$1.47	\$1.48	100	\$1.90	\$1.90	-5.23%	09/16/22 at 15:54:19.756678683	\$1.85	11/07/22 at 15:55:40.434533727	\$1.63
10/5/22	09:30:01.697301330	1	\$1.20	\$1.21	50	\$1.26	\$1.34	-1.65%	09/16/22 at 15:54:19.756678683	\$1.85	11/07/22 at 15:55:40.434533727	\$1.63
10/10/22	09:30:05.591839452	20	\$1.16	\$1.17	1,475	\$1.21	\$1.34	-3.36%	10/04/22 at 09:30:03.577312466	\$1.19	11/07/22 at 15:55:40.434533727	\$1.63

Date	Executing Purchase			Best Offer (NBBO Quote)	Baiting Orders			Price Decline <sup>1</sup>	Prior Sale by Defendant <sup>2</sup>		Next Sale by Defendant <sup>2</sup>	
	Time	Volume	Price <sup>3</sup>		Volume <sup>4</sup>	Min. Price <sup>5</sup>	Max. Price <sup>5</sup>		Time	Price	Time	Price
10/20/22	09:30:02.002549350	808	\$1.07	\$1.08	100	\$1.16	\$24.00	-0.93%	10/04/22 at 09:30:03.577312466	\$1.19	11/07/22 at 15:55:40.434533727	\$1.63
10/25/22	09:32:06.270579146	10	\$1.02	\$1.03	100	\$1.33	\$1.33	-3.77%	10/04/22 at 09:30:03.577312466	\$1.19	11/07/22 at 15:55:40.434533727	\$1.63
10/25/22	09:32:06.270579146	1	\$1.02	\$1.03	100	\$1.33	\$1.33	-3.77%	10/04/22 at 09:30:03.577312466	\$1.19	11/07/22 at 15:55:40.434533727	\$1.63
11/9/22	09:30:02.372298290	100	\$1.31	\$1.32	36,104	\$1.35	\$24.00	-1.52%	11/07/22 at 15:57:11.676017779	\$1.65	11/14/22 at 09:30:00.643786439	\$1.42
11/14/22	09:30:18.112612312	10	\$1.40	\$1.41	26,448	\$1.42	\$3.75	-2.11%	11/14/22 at 09:30:00.643786439	\$1.42	11/15/22 at 09:30:03.021798136	\$1.52
11/14/22	09:30:18.112612312	2	\$1.40	\$1.41	26,448	\$1.42	\$3.75	-2.11%	11/14/22 at 09:30:00.643786439	\$1.42	11/15/22 at 09:30:03.021798136	\$1.52
11/16/22	09:30:18.437831728	320	\$1.45	\$1.46	100	\$1.88	\$1.88	-4.05%	11/15/22 at 09:30:03.021798136	\$1.52		
11/16/22	09:33:14.110208957	1,879	\$1.40	\$1.41	100	\$1.53	\$1.81	-4.83%	11/15/22 at 09:30:03.021798136	\$1.52		
11/16/22	09:33:14.110633336	168	\$1.40	\$1.41	100	\$1.53	\$1.81	-4.83%	11/15/22 at 09:30:03.021798136	\$1.52		
11/16/22	09:33:14.657075039	1,000	\$1.40	\$1.41	100	\$1.53	\$1.81	-4.83%	11/15/22 at 09:30:03.021798136	\$1.52		
11/16/22	09:33:14.840498418	1,953	\$1.40	\$1.41	100	\$1.53	\$1.81	-4.83%	11/15/22 at 09:30:03.021798136	\$1.52		
11/18/22	09:30:15.078904577	22,000	\$1.20	\$1.21	18,702	\$1.22	\$450.00	-7.82%	11/17/22 at 15:59:00.047124906	\$1.21		
11/18/22	09:30:15.078904577	50,650	\$1.20	\$1.21	18,702	\$1.22	\$450.00	-7.82%	11/17/22 at 15:59:00.047124906	\$1.21		
11/18/22	09:30:15.501260357	4,400	\$1.20	\$1.21	18,702	\$1.22	\$450.00	-7.82%	11/17/22 at 15:59:00.047124906	\$1.21		
11/18/22	09:30:15.501349054	11,989	\$1.20	\$1.21	18,702	\$1.22	\$450.00	-7.82%	11/17/22 at 15:59:00.047124906	\$1.21		
11/18/22	09:30:21.243395889	700	\$1.20	\$1.21	30,624	\$1.22	\$450.00	-7.82%	11/17/22 at 15:59:00.047124906	\$1.21		
11/18/22	09:30:21.243500093	11,989	\$1.20	\$1.21	30,624	\$1.22	\$450.00	-7.82%	11/17/22 at 15:59:00.047124906	\$1.21		
11/18/22	09:30:23.651106399	17,500	\$1.20	\$1.21	36,559	\$1.22	\$450.00	-7.82%	11/17/22 at 15:59:00.047124906	\$1.21		
11/18/22	09:30:23.660833795	9,672	\$1.20	\$1.21	36,559	\$1.22	\$450.00	-7.82%	11/17/22 at 15:59:00.047124906	\$1.21		

Date	Executing Purchase			Best Offer (NBBO Quote)	Baiting Orders			Price Decline <sup>1</sup>	Prior Sale by Defendant <sup>2</sup>		Next Sale by Defendant <sup>2</sup>	
	Time	Volume	Price <sup>3</sup>		Volume <sup>4</sup>	Min. Price <sup>5</sup>	Max. Price <sup>5</sup>		Time	Price	Time	Price
11/18/22	09:30:23.660833795	4	\$1.20	\$1.21	36,559	\$1.22	\$450.00	-7.82%	11/17/22 at 15:59:00.047124906	\$1.21		
11/18/22	09:30:23.660833795	50	\$1.20	\$1.21	36,559	\$1.22	\$450.00	-7.82%	11/17/22 at 15:59:00.047124906	\$1.21		
11/18/22	09:30:26.464733340	200	\$1.19	\$1.20	383,689	\$1.22	\$450.00	-7.82%	11/17/22 at 15:59:00.047124906	\$1.21		
11/29/22	09:30:05.411584858	50	\$1.08	\$1.09	23,835	\$1.12	\$450.00	-1.83%	11/17/22 at 15:59:00.047124906	\$1.21		
3/15/23	09:30:20.706990669	167	\$0.77	\$0.771	82,549	\$0.771	\$288.00	-1.35%	03/06/23 at 15:59:37.991619109	\$0.93	03/17/23 at 15:55:00.588765767	\$0.78
<b>Total</b>		<b>647,119</b>			<b>82,717,302</b>							

# Exhibit 2

**Exhibit 2: List of Sales by Plaintiff**

<b>Transaction Date</b>	<b>Number of Shares Sold</b>	<b>Average Price per Share</b>	<b>Dollar Volume of Sales</b>
1/8/21	16,724	\$ 1.35	\$ 22,577.40
1/8/21	15,795	\$ 1.35	\$ 21,323.25
1/8/21	15,981	\$ 1.35	\$ 21,574.35
1/8/21	21,184	\$ 1.35	\$ 28,598.40
1/8/21	15,052	\$ 1.35	\$ 20,320.20
1/8/21	13,008	\$ 1.35	\$ 17,560.80
1/22/21	301,583	\$ 1.29	\$ 389,042.07
1/25/21	428,538	\$ 1.41	\$ 604,238.58
1/26/21	1,940,000	\$ 2.18	\$ 4,229,200.00
2/12/21	11,761,111	\$ 2.25	\$ 26,462,499.75
6/28/21	86,584	\$ 1.35	\$ 116,888.40
6/29/21	530,000	\$ 1.48	\$ 784,400.00
6/30/21	75,000	\$ 1.47	\$ 110,250.00
7/1/21	100,000	\$ 1.35	\$ 135,000.00
7/2/21	100,000	\$ 1.30	\$ 130,000.00
7/21/21	100,000	\$ 1.13	\$ 113,000.00
7/22/21	100,000	\$ 1.11	\$ 111,000.00
7/23/21	80,547	\$ 1.09	\$ 87,796.23
7/26/21	200,000	\$ 1.09	\$ 218,000.00
7/27/21	2,097	\$ 1.08	\$ 2,264.76
7/28/21	285,248	\$ 1.09	\$ 310,920.32
8/2/21	95,825	\$ 1.10	\$ 105,407.50
8/4/21	20,430	\$ 1.08	\$ 22,064.40
8/5/21	37,700	\$ 1.05	\$ 39,585.00
8/6/21	545,840	\$ 1.07	\$ 584,048.80
8/9/21	23,885	\$ 1.15	\$ 27,467.75
9/2/21	20,135	\$ 1.15	\$ 23,155.25
9/13/21	28,901	\$ 1.06	\$ 30,635.06
9/14/21	2,246	\$ 1.05	\$ 2,358.30
9/16/21	29,763	\$ 1.01	\$ 30,060.63
9/17/21	102,405	\$ 1.05	\$ 107,525.25
9/28/21	57,191	\$ 0.96	\$ 54,903.36
9/29/21	18,354	\$ 0.96	\$ 17,619.84
9/30/21	88,503	\$ 0.93	\$ 82,307.79
10/1/21	93,490	\$ 0.93	\$ 86,945.70
10/4/21	47,400	\$ 0.88	\$ 41,712.00
10/5/21	139,714	\$ 0.89	\$ 124,345.46

**Exhibit 2: List of Sales by Plaintiff**

<b>Transaction Date</b>	<b>Number of Shares Sold</b>	<b>Average Price per Share</b>	<b>Dollar Volume of Sales</b>
10/6/21	74,048	\$ 0.88	\$ 65,162.24
10/11/21	100,000	\$ 0.93	\$ 93,000.00
10/13/21	35,124	\$ 0.95	\$ 33,367.80
10/15/21	216,519	\$ 1.00	\$ 216,519.00
10/18/21	5,148	\$ 1.03	\$ 5,302.44
10/20/21	3,600	\$ 1.08	\$ 3,888.00
10/21/21	8,000,000	\$ 1.64	\$ 13,120,000.00
10/22/21	1,410,615	\$ 5.65	\$ 7,969,974.75
10/26/21	5,394,697	\$ 5.19	\$ 28,004,951.07
10/27/21	2,700,034	\$ 5.27	\$ 14,231,069.20
8/17/22	100,000	\$ 1.68	\$ 168,000.00
8/17/22	100,000	\$ 1.68	\$ 168,040.00
8/18/22	70,000	\$ 1.54	\$ 107,800.00
8/18/22	70,000	\$ 1.54	\$ 107,912.00
9/14/22	1,350,500	\$ 1.77	\$ 2,390,385.00
9/14/22	1,350,500	\$ 1.77	\$ 2,391,870.55
9/15/22	254,274	\$ 1.89	\$ 480,577.86
9/15/22	254,274	\$ 1.89	\$ 481,264.40
9/16/22	336,201	\$ 1.80	\$ 605,161.80
9/16/22	336,201	\$ 1.80	\$ 605,800.58
9/19/22	82,485	\$ 1.80	\$ 148,473.00
9/19/22	82,485	\$ 1.80	\$ 148,497.75
11/7/22	430,000	\$ 1.53	\$ 658,158.00
3/9/23	2,316	\$ 0.82	\$ 1,903.06
3/9/23	27,125	\$ 0.82	\$ 22,288.61
3/9/23	34,100	\$ 0.82	\$ 28,019.97
3/9/23	33,495	\$ 0.82	\$ 27,522.84
3/9/23	31,964	\$ 0.82	\$ 26,264.82
3/9/23	29,063	\$ 0.82	\$ 23,881.07
3/9/23	23,122	\$ 0.82	\$ 18,999.35
3/9/23	2,486	\$ 0.82	\$ 2,042.75
3/9/23	26,520	\$ 0.82	\$ 21,791.48
3/9/23	8,670	\$ 0.82	\$ 7,124.14
3/9/23	2,814	\$ 0.82	\$ 2,312.26
3/9/23	2,571	\$ 0.82	\$ 2,112.59
3/9/23	9,820	\$ 0.82	\$ 8,069.09
3/9/23	9,266	\$ 0.82	\$ 7,613.87



**Exhibit 2: List of Sales by Plaintiff**

<b>Transaction Date</b>	<b>Number of Shares Sold</b>	<b>Average Price per Share</b>	<b>Dollar Volume of Sales</b>
3/9/23	2,391	\$ 0.82	\$ 1,964.68
3/9/23	2,890	\$ 0.82	\$ 2,374.71
3/9/23	31,114	\$ 0.82	\$ 25,566.37
3/9/23	2,285	\$ 0.82	\$ 1,877.58
3/9/23	26,011	\$ 0.82	\$ 21,373.24
3/9/23	8,351	\$ 0.82	\$ 6,862.02
3/9/23	21,423	\$ 0.82	\$ 17,603.28
4/19/23	20,000	\$ 0.67	\$ 13,394.00
4/20/23	43,700	\$ 0.63	\$ 27,491.67
4/21/23	24,400	\$ 0.62	\$ 15,054.80
4/24/23	28,805	\$ 0.61	\$ 17,588.33
4/25/23	20,400	\$ 0.60	\$ 12,295.08
4/26/23	42,100	\$ 0.56	\$ 23,702.30
4/27/23	42,227	\$ 0.58	\$ 24,436.76
<b>Total</b>	<b>40,856,368</b>		<b>\$ 107,933,303</b>

# Exhibit 3

# Exhibit 7

**UNITED STATES DISTRICT COURT**

**SOUTHERN DISTRICT OF NEW YORK**

ALASKA ELECTRICAL PENSION FUND, et al.,

Plaintiffs,

--v--

BANK OF AMERICA CORP., et al.,

**Defendants.**

[illegible]

Civil Action No. 14-cv-7126 (JMF)

## EXPERT REPORT OF PROFESSOR PAUL MILGROM

**HIGHLY CONFIDENTIAL**  
**SUBJECT TO PROTECTIVE ORDER**

**January 22, 2018**

## TABLE OF CONTENTS

I.	Assignment.....	1
II.	Background and Qualifications .....	2
III.	Dr. Pirrong Accurately Summarizes the Market Microstructure Literature Regarding the Permanent Price Impact of Potentially Informed Manipulative Trades .....	3
IV.	Dr. Glosten Fails to Establish His Claim That the Price Impact of Manipulative Trades Is Only Temporary .....	7
	A. Manipulative Trades Should be Viewed as <i>Potentially</i> Informed, Not as “Uninformed” ..	7
	B. Potentially Informed Manipulative Trades Result in Permanent Price Impacts .....	10
V.	Conclusion .....	18

1. I submit this report in support of Plaintiffs' motion for class certification. The scope of my engagement and my qualifications are set forth below. By way of background, together with one of the Defendants' experts, Professor Lawrence R. Glosten, I am the co-author of a paper that both Dr. Glosten and Dr. Craig Pirrong, one of the Plaintiffs' experts, have cited: "Bid, Ask and Transactions Prices in a Specialist Market with Heterogeneously Informed Traders," *Journal of Financial Economics* 14, no.1 (1985): 71–100.

2. As I detail below, Dr. Pirrong's interpretation that potentially informed manipulative trades can have a permanent price impact accords with the analysis that Dr. Glosten and I put forward in that paper. By contrast, Dr. Glosten's critiques that manipulative trades have no permanent price impact are not supported by the market microstructure literature.

#### **I. Assignment**

3. Plaintiffs' counsel have asked me to opine on two issues:

(1) *First*, whether Dr. Pirrong accurately interpreted the market microstructure literature regarding the price impact from potentially informed manipulative trades.

(2) *Second*, whether Dr. Glosten's claim that there is no permanent price impact from manipulative trades is overstated.

4. Based on my expertise in the area of market microstructure, including the effects of trading activity and information on price, as well as my expertise in a wide range of fields of economics, I am of the opinion that:

(1) Dr. Pirrong's report fairly and accurately characterizes the market microstructure literature and the principles it teaches; and

(2) Dr. Glosten's assertion that there is no permanent impact from manipulative trades is unsound, as it is often based on a misinterpretation or mischaracterization of the relevant market microstructure literature.

5. The balance of my report is organized as follows:

**Section II** provides an overview of my background and qualifications, including in the area of market microstructure.

**Section III** contrasts Dr. Pirrong's and Dr. Glosten's stated understandings and interpretations of the market microstructure literature.

**Section IV** discusses Dr. Glosten's critiques concerning the temporary nature of price impact from manipulative trades.

**Section V** provides concluding remarks.

## **II. Background and Qualifications**

6. I am the Shirley R. and Leonard W. Ely Jr. Professor of Humanities and Sciences, School of Humanities and Sciences, as well as Professor, by courtesy, of Management Science and Engineering, School of Engineering, and of the Graduate School of Business, at Stanford University. I am also a Senior Fellow at the Stanford Institute for Economic Policy Research. My prior teaching positions include: Professor of Economics (1987–1993), Stanford University Economics Department; Professor of Management (1983–1985) and Williams Brothers Professor of Management (1985–1987), Yale University; and Assistant Professor and Professor of Economics (1979–1983), Northwestern University.

7. My work has earned me the following awards and honors:

- John J. Carty Award for the Advancement of Science from the U.S. National Academy of Sciences (2018);
- CME Group-MSRI prize in Innovative Quantitative Applications, Chicago Mercantile Exchange and Mathematical Sciences Research Institute (2017);
- BBVA Foundation Frontiers of Knowledge Prize (2012);

- Nemmers Prize in Economics, Northwestern University (2008);
- Member, National Academy of Sciences (2006);
- Honorary Doctorate, Stockholm School of Economics (2001);
- Fellow, American Academy of Arts and Sciences (1992);
- Fellow, Econometric Society (1984).

8. My *curriculum vitae* is attached as Appendix 1. It lists all of the publications that I have authored during my career, as well as the cases or matters in which I have testified as an expert since 2000.

9. I am being compensated at a rate of \$1400 per hour for my work in this litigation, and was assisted by a team working under my direction and control at Auctionomics. My compensation is not contingent upon my opinions or the outcome in this matter. A list of the materials that I relied upon in the preparation of this report is attached as Appendix 2.

### **III. Dr. Pirrong Accurately Summarizes the Market Microstructure Literature Regarding the Permanent Price Impact of Potentially Informed Manipulative Trades**

10. Dr. Pirrong and Dr. Glosten agree that the market microstructure literature distinguishes between two kinds of price impacts due to individual trades: (i) temporary impacts, which are expected to be quickly reversed; and (ii) permanent impacts, which arise when a trade is made by a trader that other market participants believe *may* have private information about the value of the traded security.

11. **Temporary price impacts:** According to the market microstructure literature, temporary price impacts can arise because market makers try to hold an ideal level of inventory, neither too high nor too low, to perform their role as a counterparty for other traders in a security. If a market maker with an ideal level of inventory buys a security, then after the trade it holds



more inventory than desired, so it lowers its bid and ask prices in an attempt to bring its inventory back toward its ideal level. After a market maker sells, the directional effects are the opposite. According to empirical literature cited in Dr. Pirrong's report, these price adjustments associated with inventory rebalancing are temporary and tend to be reversed within a small number of trades. Dr. Pirrong and Dr. Glosten do not appear to disagree on the subject of temporary price impacts caused by market makers' inventory rebalancing.

12. **Permanent price impacts:** In contrast, trading can also result in permanent price impacts due to *adverse selection*, according to which market participants anticipate the possibility that a trader may have private information to indicate that the price of the security is too low or too high. If a trader who other market participants believe may potentially be privately informed elects to *buy*, then those other market participants are led to *increase* their own estimates of the value of the security and to set *higher* bid and ask prices for the next trades. Similarly, if such a trader elects to *sell*, then other participants will *reduce* their estimates of the value and set *lower* bid and ask prices for the next trades. These revised prices become a new baseline for all future price changes, and the expected value of any further changes are *zero* (see paragraph 15 below).

13. The market microstructure literature terms as “informed” trades those made by traders on the basis of private information relevant to the underlying value of the security.<sup>1</sup> However, other market participants may be uncertain about which trades are based on such information. When there is such uncertainty, these trades are “potentially informed.”

---

<sup>1</sup>As Dr. Glosten testified, [REDACTED]

[REDACTED] Glosten Tr. at 95:8–16; 96:14–97:19.

14. Dr. Pirrong and Dr. Glosten appear to agree that the adverse selection effects identified by the Glosten-Milgrom analysis occur not only for informed trades, but for *potentially* informed trades as well.<sup>2</sup> Even if a particular trade is not actually informed, other market participants, who are unable to discern whether the particular trade is informed or uninformed, would regard that trade as potentially informed. Unless substantially *all* market participants eventually discover that the trade is uninformed, market microstructure theory allows that this uninformed trade could still have a permanent impact.

15. The phrase “permanent price impact” used in Dr. Pirrong’s report and similar phrases used in the market microstructure literature refer to the “martingale property” of transactions prices, as predicted by the Glosten-Milgrom theory. A sequence of prices that has been adjusted to eliminate temporary effects due to inventory rebalancing has the martingale property if the following relationship holds: *conditional on all the publicly available information at the time of any trade, including the price at which the trade takes place, the expected value of the price for the next transaction, and for any future transaction, is equal to the current price.*

16. Dr. Glosten’s report appears to adopt a different interpretation of the phrase “permanent price impact.” He argues that the price impact of any manipulative trade should be expected to be reversed entirely, and so is not “permanent.” He seems to identify the permanent impact of a manipulative trade with the change in the expected value of future transactions prices conditional not only on all public information, but also on the additional, non-public information that the trade is an uninformed, manipulative trade. Including this additional information in the

---

<sup>2</sup> Glosten report, ¶¶ 19–20.

expected value computation, Dr. Glosten claims, leads to the conclusion that this impact is zero: none of the price impact of a manipulative trade will be permanent.<sup>3</sup>

17. To support this conclusion, however, Dr. Glosten implicitly makes two assumptions, neither of which is standard in the market microstructure literature. The first of these is that if market participants could identify manipulative trades, they would regard them as uninformed trades. The second is that soon after any manipulative trade is made, it can be detected by other market participants. As I explain in Section IV.A, Dr. Glosten's arguments for these two premises are speculative and the premises themselves are not supported by the market microstructure literature.

18. If either of the two Glosten assumptions is incorrect, then some manipulative trades would continue to be regarded by other market participants as potentially informed. Such trades would have "permanent" price impacts, even using that term as in Dr. Glosten's report.

19. Although Dr. Glosten's report claims to the contrary that only informed trades can have a permanent price impact, the market microstructure literature does not support that claim: it consistently holds that even *potentially* informed trades can result in a *permanent* price impact. Moreover, if, as Dr. Glosten posits, some other market participants knew with certainty that trades were manipulative and uninformed, and had the incentive to profit on the mispricing, they would trade immediately to preserve the advantage of their private information. Consequently, an observed change in the bid/ask price of the security that persists following the trade would negate Dr. Glosten's premise that other market participants knew that a trade was manipulative and that its reversal was in their interest.

---

<sup>3</sup> Glosten report, ¶ 19.

20. Dr. Glosten further offers four reasons why a manipulative trade must be unwound in ways that would reverse the price impact of the original trade, so that its price impact would be only temporary.<sup>4</sup> However, these reasons are again insufficient to justify the conclusion of no permanent price impact, and they also are inconsistent with the market microstructure literature, as I explain in Section IV.B.

21. Using the phrase “permanent price impact” as it is used in the market microstructure literature and setting aside Dr. Glosten’s assumptions and claims, which are inconsistent with that literature, Dr. Pirrong is correct in finding that potentially informed trades can have a permanent impact on prices. Because manipulative trades are viewed by market participants as potentially informed, and potentially informed trades can result in permanent price impact, manipulative trades can lead to permanent price impact. Therefore, Dr. Pirrong offers a fair and accurate characterization of the market microstructure theory regarding the permanent price impact of manipulative trades.

#### **IV. Dr. Glosten Fails to Establish His Claim That the Price Impact of Manipulative Trades Is Only Temporary**

##### **A. Manipulative Trades Should be Viewed as *Potentially* Informed, Not as “Uninformed”**

22. Dr. Glosten’s conclusion—that manipulative trades have no permanent price impact—relies explicitly on his premise that all market participants know “with certainty” that manipulative trades are “uninformed.”<sup>5</sup> His premise, however, represents a substantial departure from the related market microstructure literature. In much of this literature, market manipulators

---

<sup>4</sup> Glosten report, ¶¶ 28–35.

<sup>5</sup> Dr. Glosten writes: “If market participants *knew with certainty* that a transaction is uninformed, there would be no permanent effect on the price” (Glosten report, ¶ 19, emphasis added). Also: “If the market *knows* that a trade is not based on private information, the expected value of the contract will not change after the trade, that is, uninformed trades will not have a permanent impact on prices” (Glosten report, ¶ 16, emphasis added).

are treated as making some informed and some uninformed trades, with other traders unable to distinguish between the two, leading them to treat these as potentially informed trades. Short excerpts from six such papers along with explanatory comments are presented in a footnote.<sup>6</sup> Thus, the market microstructure literature is inconsistent with Dr. Glosten's premise that manipulative trades can be readily identified by all market participants.

23. Besides failing to find support in the market microstructure literature, Dr. Glosten's report fails to offer any logical support for the premise that all market participants can readily identify uninformed, manipulative trades. That premise requires—as a matter of timing—either that such trades can: (i) be *immediately* (or even *beforehand*) identified as manipulative and uninformed by market participants; or (ii) be *eventually* identified as

---

<sup>6</sup> Allen and Gale (1992) analyze a model in which market participants cannot distinguish an uninformed manipulator from an informed trader: “[i]nvestors do not know whether the entrant is an informed trader or a manipulator.” To this extent, market participants view any entrant as *potentially* informed. See F. Allen and D. Gale, “Stock-Price Manipulation,” *Review of Financial Studies* 5, no. 3 (1992): 509–511.

Aggarwal and Wu (2006) extend the analysis of Allen and Gale (1992) via a similar model in which a manipulator “pools” with an informed trader in equilibrium—that is, other market participants cannot distinguish the manipulator from an informed party. See R. K. Aggarwal and G. Wu, “Stock Market Manipulations,” *Journal of Business* 79, no. 4 (2006): 1937–1938.

Kumar and Seppi (1992), cited by both Dr. Glosten and Dr. Pirrong, proposes to represent the effect of potentially informed manipulations by using a “signal-to-noise ratio,” which measures “the ability of the [market] to predict the manipulator’s futures position and hence to predict and then filter out the manipulator’s uninformative trade...from the spot order flow.” See P. Kumar and D. Seppi, “Futures Manipulation with ‘Cash Settlement’,” *Journal of Finance* 47, no. 4 (1992): 1488–1490.

Jarrow (1994) considers a manipulator whose trades are considered to be *potentially* informed by other market participants. In his analysis, other market participants cannot discern the manipulator’s trades from other informed trades: the price “is *only a function* of the [manipulator’s] holdings in the stock and the derivative security” (emphasis added). This phrase—“*only a function*”—means that the price does *not* depend on whether the trade is manipulative. It is a formulaic way to assert that only the manipulator itself can distinguish its manipulative trades from its informed trades. See R. A. Jarrow, “Derivative Security Markets, Market Manipulation, and Option Pricing Theory,” *The Journal of Financial and Quantitative Analysis* 29, no. 2 (1994): 244–245.

Brunnermeier and Pedersen (2005) finds that “even though traders observe prices, they cannot infer other traders’ actions.” Moreover, they state that “[a]ssuming that the strategic traders can perfectly observe the actions of other strategic traders seems unrealistic.” In the context of their paper, this means that manipulative trades are indistinguishable from normal trades. See M. K. Brunnermeier and L. H. Pedersen, “Predatory Trading,” *The Journal of Finance* 60, no. 4 (2005): 1833.

Finally, Chakraborty and Yilmaz (2004) specifically model “manipulative strategic trading by informed insiders.” Every trade in their analysis is modelled as potentially informed, meaning that market participants do not know which trades are manipulative. See A. Chakraborty and B. Yilmaz, “Informed Manipulation,” *Journal of Economic Theory* 114 (2004): 133.

manipulative and uninformed by market participants.<sup>7</sup> Dr. Glosten offers no supporting evidence for these possibilities, which defy the logic of financial markets for the reasons described below.

24. First, it is highly improbable that manipulative trades can *immediately* be identified as manipulative and uninformed by market participants. For any agent in the market, the incentive to gather private information—and thus to become an informed trader—is directly related to the volume of its trades and the size of its positions. The Defendants here are among the largest market participants and have powerful incentives to be well-informed. Other participants would likely expect this, and therefore have good reason to treat their trades as potentially informed. This tendency of large traders to be well informed is also observed by others in the market microstructure literature.<sup>8</sup>

25. Second, it is also improbable that the public will *eventually* come to know which trades were manipulative and uninformed. Indeed, Defendants dispute even now which, if any, of the trades were manipulative. Their own arguments therefore refute this hypothesis. The market microstructure literature also contradicts this hypothesis.<sup>9</sup>

26. In sum, in the market microstructure literature, manipulative trades are viewed by other market participants as potentially informed, not “uninformed.” Dr. Glosten’s arguments to the contrary are inconsistent with the market microstructure literature.

---

<sup>7</sup> See note 6 above.

<sup>8</sup> For example, Aggarwal and Wu (2006) conclude that “one way to credibly pose as an informed party is to be an insider. Others such as brokers, underwriters, market makers, or large shareholders can also credibly pose as informed investors.” See R. K. Aggarwal and G. Wu, “Stock Market Manipulations,” *Journal of Business* 79, no. 4 (2006): 1937–1938.

For additional references, see note 6.

<sup>9</sup> For example, Putnins (2012) identifies as an important problem “incomplete detection (and prosecution) of manipulation.” This recognizes that the public is unlikely to know exactly which trades were manipulative, for otherwise the problem of incomplete detection would be easily resolved. See T. J. Putnins, “Market Manipulation: A Survey,” *Journal of Economic Surveys* 26, no. 5 (2012): 961–962.

**B. Potentially Informed Manipulative Trades Result in Permanent Price Impacts**

27. Dr. Glosten also argues in his report that, “in every paper cited by Dr. Pirrong, the measured permanent impact is attributed to informed, *not* uninformed (e.g., manipulative), trades.”<sup>10</sup> This, however, is a misstatement of the literature. Instead, the accurate conclusion to draw from the literature is this: permanent price impact can result from *potentially informed* trades as well as from informed trades.

28. According to the market microstructure literature, potentially informed trades lead to permanent price changes because the counterparties anticipate possible adverse selection. Glosten and Milgrom (1985) show that the possibility of adverse selection leads to permanent price changes in the sense described above, namely, that “prices at which transactions actually occur form a martingale.”<sup>11</sup> Subsequent authors have expanded on this idea theoretically and tested it empirically, while still concluding that trades viewed by other market participants as potentially informed will impact prices in a permanent way.

(1) For example, taking a theoretical perspective, Easley and O’Hara (1987) expand on the Glosten-Milgrom theory to allow trades to vary in size. In their model, “informed traders prefer to trade larger amounts at any given price. Since uninformed traders do not share this quantity bias, the larger the trade size, the more likely it is that the market maker is trading with an informed trader.” This language highlights that prices are impacted by large trades regardless of whether the trades are actually informed ones. They also show that prices “follow a martingale relative to the set

---

<sup>10</sup> Glosten report, ¶ 22.

<sup>11</sup> L. R. Glosten and P. R. Milgrom, “Bid, Ask, and Transaction Prices in a Specialist Market with Heterogeneously Informed Traders,” *Journal of Financial Economics* 14, no. 1 (1985): 72. *See also* ¶¶ 12–15, above.

of past prices.” They interpret this as meaning that “large blocks have *persistent* price effects” (emphasis in original). See D. Easley and M. O’Hara, “Price, Trade Size, and Information in Securities Markets,” *Journal of Financial Economics* 19, no. 1 (1987): 70, 82–87.<sup>12</sup>

(2) In an empirical study, Huang and Stoll (1997) build and analyze a structural model in which adverse selection generated by potential information leads to permanent price impact. They perform a time-series analysis to distinguish empirically three components of the bid-ask spread: “order processing, adverse information, and inventory holding cost.” They state that “[q]uote adjustments for inventory reasons tend to be reversed over time, while quote adjustments for adverse information are not.” See R. D. Huang and H. R. Stoll, “The Components of the Bid-Ask Spread: A General Approach,” *The Review of Financial Studies* 10, no. 4 (1997): 997.<sup>13</sup>

29. The market microstructure literature distinguishes clearly between price impacts due to adverse selection and price impacts due to inventory effects, rather than between “informed” and “uninformed” trades.<sup>14</sup> Yet, in his report, Dr. Glosten appears to suggest that

---

<sup>12</sup> See also:

O’Hara (1998) notes that, in models with adverse selection generated by potential information, “[d]epending upon the information the market maker sees, there can be very different price adjustment paths, with some price paths closer to the true value than others. Each path, however, has the property that prices are a [m]artingale.” See M. O’Hara, *Market Microstructure Theory* (Cambridge, MA: Blackwell Publishers, 2005), 65.

<sup>13</sup> See also:

Easley, Kiefer, O’Hara, and Paperman (1996) “directly measure the effect of informed trading by estimating the market maker’s beliefs” (emphasis in original). They do so by using “the information in trade data to estimate the *probability of informed trade*” (emphasis added). See D. Easley, N. M. Kiefer, M. O’Hara and J. B. Paperman, “Liquidity, Information, and Infrequently Traded Stocks,” *Journal of Finance* 51, no. 4 (1996), 1406–1407.

Vives (2008) states that “[t]here is evidence that market makers do face an adverse selection problem and that spreads reflect asymmetric information,” and that “there is evidence that trades have a permanent impact on prices, pointing toward the effects of private (or public) information.” See X. Vives, *Information and Learning in Markets: The Impact of Market Microstructure* (Princeton, NJ: Princeton University Press 2008), 120.

<sup>14</sup> Recall that adverse selection effects drive permanent price changes, whereas inventory effects drive temporary price changes. See ¶¶ 11–12, above.



adverse selection impacts are generated only by informed trades.<sup>15</sup> His attribution of a similar view to the market microstructure literature is unfounded. In each paper cited in note 12 of the Glosten report, ¶ 22, adverse selection is generated by *potentially* informed trades, not only “informed” trades, as Dr. Glosten appears to suggest.

(1) Quoting from Biais, Glosten, and Spatt (2005), Dr. Glosten highlights that: “[t]his literature has shown that trades have both a transitory and a permanent impact on prices. While the former can be traced back to order-handling and inventory costs, the latter reflects information.” However, “information” as used here refers to the *potential* information that generates adverse selection effects. Biais, Glosten, and Spatt (2005) also clarify that in their paper that adverse selection leads to permanent effects: “Both inventory and adverse-selection theories predict that trades impact prices, but the former predicts that this impact should be transient, while the latter predicts that this impact should be permanent.”<sup>16</sup>

(2) Dr. Glosten also cites Hasbrouck (1991) in support of his position, but Hasbrouck explains to the contrary: “trades convey information and therefore cause a persistent impact on the security price.” Furthermore, “[t]he magnitude of the price effect for a given trade size is generally held to be a positive function of *the proportion of potentially informed traders in the population, the probability that such a trader is in fact informed* (i.e., the probability that a private information signal has in fact been observed), *and the precision of the private information*” (emphasis added).<sup>17</sup> The references to the

---

<sup>15</sup> Glosten report, ¶ 22, note 12.

<sup>16</sup> See B. Biais, L. Glosten, and C. Spatt, “Market Microstructure: A Survey of Microfoundations, Empirical Results, and Policy Implications,” *Journal of Financial Markets* 8 (2005): 220, 232.

<sup>17</sup> J. Hasbrouck, “Measuring the Information Content of Stock Trades,” *Journal of Finance* 46, no. 1 (1991): 179.

“proportion” and “probability” of informed trade are included because participants cannot distinguish informed from uninformed trades, and must respond in the same ways to both.

(3) Dr. Glosten quotes from Stoll (2000): “[i]nformational trading results in permanent price changes” and “[p]rice changes associated with adverse information are permanent adjustments in the equilibrium price.” The reference to adverse selection makes clear that Stoll (2000) uses “information” in the sense of *potential* information just as in the Glosten-Milgrom analysis, in which “[a] supplier of immediacy faces the *danger* that a bid or ask will be accepted by someone with superior- or adverse-information” (emphasis added). Moreover, this leads to permanent price changes: “If the source of the spread is totally informational, the bid-ask bounce, as Glosten and Milgrom (1985) first showed, will not be observed, for in that case the transaction price is a martingale.”<sup>18</sup>

(4) Dr. Glosten claims that Fleming, Mizrach, and Nguyen (2017) “conclude that the permanent price impact found in their empirical study is due to information”.<sup>19</sup> He quotes from the study: “More importantly, we show that limit order activities affect prices, and in fact contribute more to the variance of efficient price updates than trades [...] The evidence that limit orders also contain value-relevant information suggests that, contrary to the conventional assumption that traders with better information are liquidity demanders.” However, this quote does not support Dr. Glosten’s claim.

---

<sup>18</sup> See H. R. Stoll, “Friction,” *Journal of Finance* 55, no. 4 (2000): 1482–1483, 1485, 1492.

<sup>19</sup> Glosten report, ¶ 22, note 12.

(a) The authors use the term “information” to mean *potential* information. They state explicitly that their methodology is “rooted in theoretical microstructure models of information asymmetry. Upon observing a trade, the market maker infers the *probability of trading with an informed trader*, and update prices accordingly” (emphasis added).

(b) Fleming, Mizrach, and Nguyen (2017) further note that this leads to permanence of price impact, in the sense of the martingale condition: “The price revision process thus reflects the information set of the market maker at each price update, which includes the contemporaneous trade, as well as the history of trades and prices.”<sup>20</sup>

(5) Dr. Glosten quotes from Kraus and Stoll (1972): “The evidence tends to support the liquidity cost version of the distribution hypothesis ... [and this] conclusion is based on a number of pieces of evidence the most important of which is the rapid price recovery of minus tick blocks [i.e., sales] on the day of the block.” However, this does not attribute permanent effects only to informed trades, as Glosten claims in ¶ 22. The logic of Kraus and Stoll (1972) is that because the empirically measured price impact is temporary, the trades considered cannot be based on potential information. As the authors write by way of conclusion: “The purpose of the preceding analyses was to investigate whether the price effects accompanying block trades can be ascribed to a change in the underlying value of the stock (information effect) or to a temporary deviation of prices (distribution effect).” Kraus and Stoll (1972) pre-dates the the

---

<sup>20</sup> See M. J. Fleming, B. Mizrach, and G. Nguyen, “The Microstructure of a U.S. Treasury ECN: The BrokerTec Platform,” *Journal of Financial Markets*, forthcoming (2017): 3, 15–16.

Glosten-Milgrom analysis, and so the authors do not explicitly distinguish between information and potential information.<sup>21</sup>

(6) Dr. Glosten quotes from Huang and Stoll (1996) that their result of permanent price changes on the NYSE are “consistent with the presence of adverse information.” However, as noted above, adverse selection arises from potential information, so this quotation is inconsistent with Dr. Glosten’s position.<sup>22</sup>

(7) From Madhavan and Cheng (1997), Dr. Glosten quotes that the authors find that “asymmetric information is a major component of the price impact.” *Asymmetrically informed* traders, however, are the same as *potentially informed* traders: they alone know whether they have relevant private information about the value of the security and what its significance may be. To the extent that market participants cannot distinguish informed trades from uninformed ones, trades are viewed by market participants as potentially informed and result in adverse selection, which drives permanent price changes.<sup>23</sup>

(8) Dr. Glosten’s contention about Dr. Pirrong’s use of Glosten and Harris (1988) is simply that the paper “[does] not make any inference between the findings [...] and manipulative trading”.<sup>24</sup> Glosten and Harris (1988) does, however, distinguish between the “transitory component” and the “adverse-selection component” of the bid-ask spread. They explain that, as “[i]n the Glosten and Milgrom (1985) model, the adverse-selection spread

---

<sup>21</sup> See A. Kraus and H. R. Stoll, “Price Impacts of Block Trading on the New York Stock Exchange,” *Journal of Finance* 27, no. 3 (1972): 587.

<sup>22</sup> See R. D. Huang and H. R. Stoll, “Dealer versus Auction Markets: A Paired Comparison of Execution Costs on NASDAQ and the NYSE,” *Journal of Financial Economics* 41, no. 3 (1996): 334.

<sup>23</sup> See A. Madhavan and M. Cheng, “In Search of Liquidity: Block Trades in the Upstairs and Downstairs Markets,” *Review of Financial Studies* 10, no. 1 (1997): 190.

<sup>24</sup> Glosten report, ¶ 22, note 12.

component is equal to the revision in market-maker expectations of stock resulting from the submission of an order. When someone submits an order to buy (or sell) stock, the uninformed market-maker, knowing that the order *might* be information-motivated, revises his expectation of the future stock value upward (or downward)” (emphasis added). This supports the argument that *potentially* informed trades result in adverse selection, which leads to permanent price impact. Thus, to the extent that manipulative trades are potentially informed trades, the paper’s findings do apply.<sup>25</sup>

(9) From Kumar and Seppi (1992), Dr. Glosten notes that one conclusion the paper draws is that there is “price pressure (i.e., subsequently reversed price changes)” following manipulation. Taken in context, this quote addresses the price pressure in the futures market, not in the market for the underlying stock. The futures order flow in that portion of their analysis is known by all market participants to be “completely uninformative about fundamentals,” or the value of the underlying security, and so leads to temporary pressure on the futures price. By contrast, in the same model, both uninformed and informed traders trade in the spot market for the underlying stock. Trades in the spot market are treated as *potentially* informed by market participants, and drive adverse selection.<sup>26</sup>

30. Despite the literature, Dr. Glosten also takes a different approach to these same issues, offering four reasons that if a trade is manipulative, it might be unwound, thus reversing the price impact and rendering that impact temporary, rather than permanent.<sup>27</sup> These reasons all rely on claims that are neither implied nor supported by the market microstructure literature.

---

<sup>25</sup> See L. R. Glosten and L. E. Harris, “Estimating the Components of the Bid/Ask Spread,” *Journal of Financial Economics* 21 (1988): 124.

<sup>26</sup> See P. Kumar and D. J. Seppi, “Futures Manipulation with ‘Cash Settlement’,” *Journal of Finance* 47, no. 4 (1992): 1486, 1495.

<sup>27</sup> Glosten report, ¶¶ 28–35.

31. First, Dr. Glosten asserts that, after a manipulative trade, the manipulative trader would be left with inventory to rebalance by “unwinding” the manipulation. There is, however, no symmetry in the manipulative trade and its unwinding. A manipulative trader who wants, for example, to raise a price will buy in a way that *maximizes* the price impact. However, when unwinding the trade, that same trader will seek to *minimize* the price impact to avoid losses. Therefore, the upward effect can be expected to exceed the downward effect from unwinding—and that difference may represent a permanent effect.

32. Second, professional traders and others will tend to act on the mistaken pricing. Dr. Glosten posits that these market participants might try to detect manipulative trades. But Dr. Glosten fails to account for the corresponding incentive of manipulative traders to conceal their intent, in order to benefit from their manipulation and unwind their positions to avoid or minimize loss.

33. Third, Dr. Glosten notes that the market participants themselves will have an incentive to take advantage of the mispricing. Like the first reason above, however, Dr. Glosten again ignores trader incentives to minimize price impact while unwinding their position.

34. Fourth, according to Dr. Glosten, other co-conspirators may trade similarly based on their knowledge that the trade was manipulative and that the price level is artificial. But like the second reason, Dr. Glosten’s fourth reason relies on other market participants’ ability to recognize manipulative trades, and their confidence that each trade is uninformed, rather than potentially informed. However, as noted above, both of these assumptions are contrary to the weight of the market microstructure literature.<sup>28</sup>

---

<sup>28</sup> In particular, see Section IV.A, above.

35. Thus, Dr. Glosten's four reasons that manipulative trades would be unwound in ways that completely reverse their price impacts is unpersuasive as a matter of logic, as well as unsupported by the market microstructure literature. The market microstructure literature demonstrates clearly how potentially informed trades can result in permanent price impact. Therefore, as Dr. Pirrong opines, manipulative trades are likely to have a permanent price impact.

#### **V. Conclusion**

36. In summary, Dr. Pirrong accurately interprets the market microstructure literature regarding the permanent price impact of potentially informed trades. To the extent that manipulative trades are viewed by other market participants as potentially informed, they have a permanent price impact. Dr. Glosten's claims to the contrary are not convincing and are not supported by the market microstructure literature.

January 22, 2018



Dr. Paul Milgrom

## **Appendix 1**

### **Paul Robert Milgrom**

**Shirley and Leonard Ely, Jr. Professor of Humanities and Sciences  
Department of Economics  
Stanford University**

579 Serra Mall, Landau Economics Building  
Stanford, CA 94305  
+1 (650) 723-3397  
milgrom@stanford.edu

#### **Education**

Ph.D. in Business, Stanford University, January 1979

M.S. in Statistics, Stanford University, April 1978

A.B. in Mathematics with high honors, University of Michigan, May 1970

#### **Employment**

2007–present	Senior Fellow, SIEPR, Stanford University
1993–present	Shirley and Leonard Ely, Jr. Professor of Humanities and Sciences, Stanford University
1987–present	Professor of Economics, Stanford University Professor (by courtesy), Graduate School of Business Professor (by courtesy), Department of Management Science and Engineering
1989–91	Director, Stanford Institute for Theoretical Economics
1985–87	Williams Brothers Professor of Management Studies and Professor of Economics, Yale University
1983–85	Professor of Economics and Management, Yale University
1982–83	Visiting Professor, Yale University



- Professor, Department of Managerial Economics and Decision Sciences,  
Kellogg Graduate School of Management, Northwestern University
- 1981–82 Associate Professor, Department of Managerial Economics and Decision  
Sciences, Kellogg Graduate School of Management, Northwestern  
University
- 1979–81 Assistant Professor, Department of Managerial Economics and Decision  
Sciences, Kellogg Graduate School of Management, Northwestern  
University

**Honors, Awards, Prizes, Fellowships, and Grants**

- 2018 John J. Carty Award for the Advancement of Science, U.S. National  
Academy of Sciences
- 2017 CME Group-MSRI prize in Innovative Quantitative Applications, Chicago  
Mercantile Exchange and Mathematical Sciences Research Institute  
McKenzie lecture, University of Rochester  
Stanford Humanities and Sciences Dean’s Award for Excellence in Graduate  
Education  
Elected Fellow of the Game Theory Society  
Elected Fellow of the Finance Theory Group
- 2016 Nancy Schwartz Memorial Lecture, Northwestern University
- 2015 National Science Foundation Award “Auction Market Design”  
Simon’s Institute Public Lecture, University of California, Berkeley  
WINE (Web and Internet Economics) Keynote Lecture
- 2014 Golden Goose Award  
Keyfitz Lecture, Fields Institute, Toronto  
Arrow Lecture, Columbia University
- 2013 Nomura Lecturer, Institute of Mathematics, Oxford University  
BBVA Foundation Frontiers of Knowledge Award in Economics, Finance  
and Management
- 2012 Elected Vice President of the American Economic Association (term to  
begin in 2013)

- Inaugural lecture on “Incentive Auctions for Radio Spectrum,” C.V. Starr Center Distinguished Speaker Series, New York University
- Oskar Morgenstern lecture on “Designing the US ‘Incentive Auctions’,” Fourth World Congress of the Game Theory Society
- Becker Friedman Visitor, University of Chicago
- Intertic Stackelberg Lecture on “Auctions for Online Display Advertising”
- 2011 Eitan Berglas Lecture on “The Applied Science of Market Design,” Tel Aviv University
- 2010 NSF-SBIR Phase IB Award for “Incorporating Bidder Budget Constraints in Multi-item Auctions”
- 2009 NSF-SBIR Phase I Award for “Incorporating Bidder Budget Constraints in Multi-Item Auctions”
- Nemmers Lecture, Northwestern University
- EARIE (European Association for Research in Industrial Organization) Lecture
- 2008 Erwin Plein Nemmers Prize
- W.A. Mackintosh Lecture, Queens University
- Simon Newcomb Lecture, Johns Hopkins University
- 2007 President, Western Economic Association International (WEAI)
- National Science Foundation Grant on “Market Design”
- 2006 Elected to the National Academy of Sciences
- Colin Clarke Lecture, Econometric Society Australasian Meeting
- Manchot Lecture, University of Bonn
- 2005 Elected to the Executive Committee of the Econometric Society
- Elected Vice President of the Western Economic Association
- Chung-Hua Lecturer, Academia Sinica (Taiwan)
- Clarendon Lecturer, Oxford University
- 2004 Fischer-Schulz Lecturer, Econometric Society
- Koopmans Lecturer, Yale University
- National Science Foundation Research Grant to study “Electronic Auction

- Markets”  
Council Member, Econometric Society
- 2003 National Science Foundation Research Grant to study “Cumulative Offer Processes”  
Landau Economics Teaching Prize, Stanford University  
Elected to the Council, Game Theory Society  
Distinguished Economist Lecture, Federal Communications Commission
- 2001 Honorary Doctorate, Stockholm School of Economics
- 2000 Taussig Visiting Research Professor, Harvard University
- 1999 Murray S. Johnson Inaugural Lecture, University of Texas  
Industry Canada Distinguished Lecture
- 1998 Fain Lecture, Brown University  
Lawrence Klein Lecture, University of Pennsylvania  
Fellow (2nd time), Center for Advanced Study in the Behavioral Sciences
- 1997 Alberto Bailleres Founder’s Lecture at Instituto Tecnológico Autónomo de México (ITAM)  
Plenary Lecturer, Econometric Society Far Eastern Meeting  
Plenary Lecturer, Australian Industry Economics Meeting, University of Melbourne
- 1996 Nobel Prize Memorial Lecture (honoring deceased Nobel laureate William Vickrey) at the Royal Swedish Academy of Sciences
- 1995 Churchill Lectures at Cambridge University  
Political Economy Special Lecture at Harvard University
- 1994 National Science Foundation Research Grant to study “Comparative Statics, Complementarities, Coordination and Change,” (covering 1994 to 1997)  
Woytinsky Distinguished Lecturer, University of Michigan
- 1993 Senior Research Fellow, Institute for Policy Reform  
Shirley R. and Leonard W. Ely, Jr. Professor of Humanities and Sciences, Stanford University
- 1992 Fellow, American Academy of Arts and Sciences

- International Guest Scholar, Kyoto University
- 1991 Fellow, Center for Advanced Study in the Behavioral Sciences  
National Science Foundation Research Grant to study “Theories of the Firm 2” (covering 1991 to 1994)
- 1990 Center for Economic Policy Research Grant to study “The Economics of Modern Manufacturing”
- 1989 National Science Foundation Grant to direct programs for the Stanford Institute for Theoretical Economics  
National Academy of Sciences Award to lecture in China on economics of organizations
- 1988 Olin Distinguished Lecturer, Princeton University  
National Science Foundation Research Grant to study “Theories of the Firm” (covering 1988 to 1991)  
Center for Economic Policy Research Grant
- 1987 Prize for Best Paper of the Year in the Transactions of the Society of Actuaries
- 1986 Ford Visiting Professor of Economics, University of California, Berkeley  
John Simon Guggenheim Fellowship to study “Economic Theories of Organization”
- 1985 Williams Brothers Chair in Management Studies, Yale University  
National Science Foundation Research Grant to study “On the Formal Economic Theory of Organizations”  
Fellow of the Institute for Advanced Studies, Hebrew University of Jerusalem  
Plenary Lecturer at the Fifth World Congress of the Econometric Society
- 1984 Fellow of the Econometric Society  
Fellow of Morse College, Yale University
- 1983 Research Award, Actuarial Education and Research Fund  
Honorary Master of Arts degree, Yale University
- 1982 National Science Foundation Research Grant to study “The Structure of

- Information in a Productive Organization”
- 1981 IBM Research Chair at Northwestern University  
Visiting Research Associate, Stanford University
- 1980 Leonard J. Savage Memorial Thesis Award  
National Science Foundation Research Grant to study “Information and Uncertainty in Competitive Bidding”
- 1976 Society of Actuaries Triennial Paper Prize for best paper by an actuary within five of membership, for the period 1973–75
- 1974 Fellow of the Society of Actuaries

## **Publications**

### **Articles**

- “Equilibrium Selection in Auctions and High Stakes Games,” with Joshua Mollner, *Econometrica*, forthcoming
- “Redesigning Spectrum Licenses,” with Anthony Zhang and E. Glen Weyl, *Regulation*, Fall 2017.
- “Economics and Computer Science of a Radio Spectrum Reallocation,” with Kevin Leyton-Brown and Ilya Segal, *Proceedings of the National Academy of Sciences*, July 2017.
- “Adverse Selection and Auction Design in Internet Display Advertising,” with Nick Arnosti and Marissa Beck, *American Economic Review*, October 2016.
- “Ascending Prices and Package Bidding: Further Experimental Analysis,” with John Kagel and Yuanchuan Lien, *Games and Economic Behavior*, May 2014.
- “Designing Random Allocation Mechanisms: Theory and Applications,” with Eric Budish, Yeon-Koo Che and Fuhito Kojima, *American Economic Review*, April 2013.
- “Critical Issues in Market Design,” *Economic Inquiry*, April 2011.
- “Simplified Mechanisms with an Application to Sponsored-Search Auctions,” *Games and Economic Behavior*, September 2010.
- “Ascending Prices and Package Bidding: A Theoretical and Experimental Analysis,” with Yuanchuan Lien and John Kagel, *American Economic Journal: Microeconomics*, August

2010.

“Online Advertising: Heterogeneity and Conflation in Market Design,” with Jon Levin, *American Economic Review*, May 2010.

“Assignment Messages and Exchanges,” *American Economic Journal: Microeconomics*, August 2009. Reprinted in *Handbook of Spectrum Auction Design*, by Martin Bichler and Jacob Goeree (eds.), Cambridge University Press, 2017.

“The Limited Influence of Unemployment on the Wage Bargain,” with Robert Hall, *American Economic Review*, September 2008. Reprinted in *Political Economy: Critical Concepts*, by Norman Schofield, Dino Falaschetti and Andrew Rutten (eds.), New York: Routledge, 2011.

“Substitute Goods, Auctions and Equilibrium,” with Bruno Strulovici, *Journal of Economic Theory*, June 2008

“The Promise of Prediction Markets” (with 22 co-authors), *Science*, May 2008.

“What the Seller Won’t Tell You: Persuasion and Disclosure in Markets,” *Journal of Economics Perspectives*, Spring 2008.

“Core-Selecting Package Auctions,” with Bob Day, *International Journal of Game Theory*, March 2008. Reprinted in *Handbook of Spectrum Auction Design*, by Martin Bichler and Jacob Goeree (eds.), Cambridge University Press, 2017.

“Package Auctions and Package Exchanges” (2004 Fisher-Schultz lecture), *Econometrica*, July 2007.

“Matching with Contracts,” with John Hatfield, *American Economic Review*, September 2005.

“Ascending Auctions with Package Bidding,” with Lawrence M. Ausubel, *Frontiers of Theoretical Economics*, August 2002. Republished in *Advances in Theoretical Economics*, 2002.

“Package Bidding: Vickrey vs Ascending Auctions,” with Lawrence M. Ausubel, *Revue Economique*, May 2002.

“Envelope Theorems for Arbitrary Choice Sets,” with Ilya Segal, *Econometrica*, March 2002.

“Advances in Routing Technologies and Internet Peering Agreements,” with Stan Besen, Bridger Mitchell and Padmanabhan Srinagesh, *American Economic Association Papers and Proceedings*, May 2001.

- “Putting Auction Theory to Work: The Simultaneous Ascending Auction,” *Journal of Political Economy*, April 2000. Reprinted in *Handbook of Spectrum Auction Design*, by Martin Bichler and Jacob Goeree (eds.), Cambridge University Press, 2017.
- “Game Theory and the Spectrum Auctions,” *European Economic Review*, May 1998.
- “Coalition-Proofness and Correlation with Arbitrary Communication Possibilities,” with John Roberts, *Games and Economic Behavior*, November 1996.
- “The LeChatelier Principle,” with John Roberts, *American Economic Review*, March 1996. Reprinted in *Paul Anthony Samuelson, Critical Assessments of Contemporary Economists*, by John Cunningham Wood and Michael McLure (eds.), New York: Routledge, 2004.
- “The Economics of Modern Manufacturing: Technology, Strategy and Organization: Reply,” *American Economic Review*, September 1995.
- “Deterring Predation in Telecommunications: Are Line-of-Business Restraints Needed?” with Susan Gates and John Roberts, *Managerial and Decision Economics*, July 1995. Reprinted in *Deregulating Telecommunications: The Baby Bells’ Case for Competition*, by R.S. Higgins and P.H. Rubin (eds). Chichester: John Wiley & Sons, 1995.
- “Complementarities and Fit: Strategy, Structure and Organizational Change in Manufacturing,” with John Roberts, *Journal of Accounting and Economics*, March 1995.
- “The Firm as an Incentive System,” with Bengt Holmstrom, *American Economic Review*, September 1994. Reprinted in *The Theory of the Firm: Critical Perspectives*, by Nicolai Juul Foss (ed.), New York: Routledge, 2000. Reprinted in *Readings in the Economics of the Division of Labor, Vol 2: Modern Analyses*, by Guang-Zhen Sun (ed.), World Scientific, 2005.
- “Coordination, Commitment and Enforcement: The Case of the Merchant Guild,” with Avner Greif and Barry Weingast, *Journal of Political Economy*, August 1994. Reprinted in *Explaining Social Institutions*, by Jack Knight and Itai Sened (eds.), Ann Arbor: University of Michigan Press, 1995. Reprinted in *Trust*, by Elias Khalil (ed.), London: Edward Elgar Publishing, 2002. Reprinted in *The Foundations Library of the New Institutional Economics*, by Claude Ménard (ed.), London: Edward Elgar Publishing, 2005. Reprinted in *Social Norms, Non-legal Sanctions, and the Law*, by Eric Posner (ed.), London: Edward Elgar Publishing, 2007. Reprinted in *Customary Law*, by Lisa Bernstein and Francesco Parisi (eds.), London: Edward Elgar Publishing, forthcoming.

- “Comparing Equilibria,” with John Roberts, *American Economic Review*, June 1994. Reprinted in *Equilibrium*, by Donald Walker (ed.), Edward Elgar Publishing, 2000.
- “Comparing Optima: Do Simplifying Assumptions Affect Conclusions?” *Journal of Political Economy*, June 1994.
- “Complementarities and Systems: Understanding Japanese Economic Organization,” with John Roberts, *Estudios Economicos*, April 1994.
- “Monotone Comparative Statics,” with Chris Shannon, *Econometrica*, January 1994.
- “Organizational Prospects, Influence Costs and Ownership Changes,” with Margaret Meyer and John Roberts, *Journal of Economics and Management Strategy*, Spring 1992.
- “Pay, Perks and Parachutes: Do They Pay?” with John Roberts, *Stanford Business*, 1992.
- “Information and Timing in Repeated Partnerships,” with Dilip Abreu and David Pearce, *Econometrica*, November 1991.
- “A Theory of Hierarchies Based on Limited Managerial Attention,” with John Geanakoplos, *Journal of Japanese and International Economies*, September 1991. Reprinted in *The Economics of Organization and Bureaucracy*, by Peter Jackson (ed.), London: Edward Elgar Publishing, 2013.
- “Complementarities, Momentum, and the Evolution of Modern Manufacturing,” with Yingyi Qian and John Roberts, *American Economic Association Papers and Proceedings*, May 1991.
- “Multitask Principal-Agent Analyses: Incentive Contracts, Asset Ownership and Job Design,” with Bengt Holmstrom, *Journal of Law, Economics and Organization*, Spring 1991. Reprinted in *Transaction Cost Economics*, by Oliver Williamson and Scott Masten (eds.), London: Edward Elgar Publishing, 1994. Reprinted in *The Principal-Agent Model: The Economic Theory of Incentives*, by J-J Laffont (ed.), Cheltenham: Edward Elgar Press, 2003. Reprinted in *The International Library of the New Institutional Economics*, by Claude Ménard (ed.), London: Edward Elgar Publishing, 2005. Reprinted in *The Economic Nature of the Firm*, by Louis Putterman and Randall Kroszner (ed.), Cambridge University Press, 1996. Reprinted in *The Economics of Contracts*, by Patrick Bolton, Barbara and David Zalaznick (eds.), Cheltenham: Edward Elgar Press, 2008. Reprinted in *Institutional Law and Economics*, by Pablo Spiller (ed.), Cheltenham: Edward Elgar Press, forthcoming.
- “Adaptive and Sophisticated Learning in Repeated Normal Form Games,” with John Roberts,



*Games and Economic Behavior*, February 1991. Reprinted in *Recent Developments in Game Theory*, by E. Maskin (ed.), Cheltenham: Edward Elgar, 1998.

“Rationalizability, Learning and Equilibrium in Games with Strategic Complementarities,” with John Roberts, *Econometrica*, November 1990. Reprinted in *Recent Developments in Game Theory*, by E. Maskin (ed.), Cheltenham: Edward Elgar, 1998.

“The Economics of Modern Manufacturing: Technology, Strategy and Organization,” with John Roberts, *American Economic Review*, June 1990. Reprinted in *Vestnik St. Petersburgskogo Universiteta, Economics Seria* (the Journal of the Economics Faculty of St. Petersburg University), 1993 (in translation). Reprinted in *Economics of the Firm: Lessons in Business Organization*, by Andrei Demin and Valery Katkalo (eds.), St. Petersburg, Russia: 1994. Reprinted in *The Economics of Communications and Information*, by Donald Lamberton (ed.), Cheltenham: Edgar Elgar Publishing, 1996. Reprinted in *Readings in Applied Microeconomic Theory: Market Forces and Solutions*, by Robert E. Kuenne (ed.), Blackwell Publishers, 2000. Reprinted in *Fundamentals of Business Strategy*, by Mie Augur and David Teece (eds.), Sage Publications, 2007.

“Short Term Contracts and Long Term Agency Relationships,” with Drew Fudenberg and Bengt Holmstrom, *Journal of Economic Theory*, June 1990.

“The Efficiency of Equity in Organizational Decision Processes,” with John Roberts, *American Economic Review Papers and Proceedings*, May 1990.

“The Role of Institutions in the Revival of Trade: The Medieval Law Merchant,” with Douglass North and Barry Weingast, *Economics and Politics*, March 1990. Reprinted in *Trade in the Pre-Modern Period: 1400-1700*, by Douglas Irwin (ed.), London: Edward Elgar Publishing, 1996. Reprinted in *Reputation: Studies in the Voluntary Elicitation of Good Conduct*, by Daniel B. Klein (ed.), Ann Arbor, University of Michigan Press, 1997. Reprinted in *The Political Economy of Institutions*, by Claude Ménard (ed.), London: Edward Elgar Publishing, 2004. Reprinted in *International Institutions in the New Global Economy*, by Lisa L. Martin (ed.), London: Edward Elgar Publishing, 2005. Reprinted in *Anarchy and the Law*, by Edward Stringham (ed.), New Brunswick, New Jersey: Transaction Publishers, 2006. Reprinted in *Social Norms, Non-Legal Sanctions, and the Law*, by Eric A. Posner (ed.), London: Edward Elgar Publishing, 2007.

“Regulating Trade Among Agents,” with Bengt Holmstrom, *Journal of Institutional and Theoretical Economics*, March 1990. Reprinted in *The New Institutional Economics*, by Erik G. Furubotn and Rudolph Richter (eds.), College Station: Texas A&M University

Press, 1991.

“Auctions and Bidding: A Primer,” *Journal of Economic Perspectives*, Summer 1989. Reprinted in *Readings in Microeconomic Theory*, by Manfredi La Manna (ed.), London: Dryden Press, 1997.

“Communication and Inventories as Substitutes in Organizing Production,” with John Roberts, *Scandinavian Journal of Economics*, September 1988.

“Economic Theories of Organization: Past, Present and Future,” with John Roberts, *Canadian Journal of Economics*, August 1988. Reprinted in *The Economics of Contracts and Industrial Organization: A Reader*, Peter Buckley and Jonathan Michie (eds.), Oxford University Press, 1996.

“An Economic Approach to Influence Activities and Organizational Responses,” with John Roberts, *American Journal of Sociology*, July 1988.

“Employment Contracts, Influence Activities and Efficient Organization Design,” *Journal of Political Economy*, February 1988.

“Job Discrimination, Market Forces, and the Invisibility Hypothesis,” with Sharon Oster, *Quarterly Journal of Economics*, August 1987. Reprinted in *Learning in Labour Markets*, by Michael Waldman (ed.), Cheltenham: Edward Elgar Press.

“Informational Asymmetries, Strategic Behavior and Industrial Organization,” with John Roberts, *American Economic Association Papers and Proceedings*, May 1987.

“Aggregation and Linearity in the Provision of Intertemporal Incentives,” with Bengt Holmstrom, *Econometrica*, March 1987. Reprinted in *The Principal-Agent Model: The Economic Theory of Incentives*, by J-J Laffont (ed.), Cheltenham: Edward Elgar Press. Reprinted in *The Economics of Contracts*, by Patrick Bolton, Barbara and David Zalaznick (eds.), Cheltenham: Edward Elgar Press.

“Price and Advertising Signals of Product Quality,” with John Roberts, *Journal of Political Economy*, August 1986. Reprinted in *Antitrust and Competition*, by Andrew Kleit (ed.), Cheltenham: Edward Elgar Publishing, 2005. Reprinted in *The Economics of Marketing*, Martin Carter, by Mark Casson and Vivek Suneja (eds.), Cheltenham: Edgar Elgar Publishing, 1998. Reprinted in *Readings in Industrial Organization*, by Luis M.B. Cabral (ed.), Oxford: Blackwell Publishers, 2000.

“Relying on the Information of Interested Parties,” with John Roberts, *Rand Journal of Economics*, April 1986. Reprinted in *Economics of Evidence, Procedure and Litigation*,

by Chris William Sanchirico (ed.), Cheltenham: Edward Elgar Publishing, 2007.

“Distributional Strategies for Games with Incomplete Information,” with Robert Weber, *Mathematics of Operations Research*, November 1985.

“Bid, Ask and Transactions Prices in a Specialist Market with Heterogeneously Informed Traders,” with Lawrence R. Glosten, *Journal of Financial Economics*, March 1985.

“Reply to the Comments on ‘Measuring the Interest Rate Risk’,” *Transactions of the Society of Actuaries*, XXXVII, 1985

“Measuring the Interest-Rate Risk,” *Transactions of the Society of Actuaries*, XXXVII, 1985.

“Competitive Bidding with Proprietary Information,” with Richard Engelbrecht-Wiggans and Robert Weber, *Journal of Mathematical Economics*, April 1983.

“A Theory of Auctions and Competitive Bidding,” with Robert Weber, *Econometrica*, September 1982. Reprinted in *Game Theory in Economics*, by Ariel Rubinstein (ed.), London: Edward Elgar Publishing, 1990. Reprinted in *The Economics of Information*, by Steven A. Lippman and John E. Anderson (eds.), London: Edward Elgar Publishing, 1994. Reprinted in *The Economic Theory of Auctions*, by Paul Klemperer (ed.), London: Edward Elgar Publishing, 1999. Reprinted in *Readings in Applied Microeconomic Theory: Market Forces and Solutions*, by Robert E. Kuenne (ed.), Blackwell Publishers, 2000.

“Predation, Reputation, and Entry Deterrence,” with John Roberts, *Journal of Economic Theory*, August 1982. Reprinted in *Antitrust and Competition*, by Andrew Kleit (ed.), Cheltenham: Edward Elgar Publishing, 2005. Reprinted in *The Economics of Reputation*, by Jill J. McCluskey and Jason Winfree (eds.), Edward Elgar Publishing, 2017.

“Rational Cooperation in the Finitely-Repeated Prisoners’ Dilemma,” with David Kreps, John Roberts and Robert Wilson, *Journal of Economic Theory*, August 1982. Reprinted in *Game Theory in Economics*, by Ariel Rubinstein (ed.), Cheltenham: Edward Elgar Publishing, 1990. Reprinted in *Trust*, by Elias L. Khalil (ed.), Cheltenham: Edward Elgar Publishing, 2003.

“The Value of Information in a Sealed Bid Auction,” with Robert Weber, *Journal of Mathematical Economics*, June 1982. Reprinted in *The Economic Theory of Auctions*, by Paul Klemperer (ed.), London: Edward Elgar Publishing, 1999.

“Limit Pricing and Entry Under Incomplete Information: An Equilibrium Analysis,” with John

Roberts, *Econometrica*, March 1982. Reprinted in *Industrial Organization*, by Oliver Williamson (ed.), London: Edward Elgar Publishing, 1990. Reprinted in *The Economics of Information*, by Steven A. Lippman and John E. Anderson (eds.), London: Edward Elgar Publishing, 1994. Reprinted in *Readings in Industrial Organization*, edited by Luis M.B. Cabral (ed.), Oxford: Blackwell Publishers, 2000. Reprinted in *Pricing*, by Michael Waldman and Justin P. Johnson (ed.), London: Edward Elgar Publishing, 2007.

“Information, Trade and Common Knowledge,” with Nancy Stokey, *Journal of Economic Theory*, February 1982.

“Good News and Bad News: Representation Theorems and Applications,” *Bell Journal of Economics*, October 1981.

“Rational Expectations, Information Acquisition, and Competitive Bidding,” *Econometrica*, July 1981. Reprinted in *The Economic Theory of Auctions*, by Paul Klemperer (ed.), London: Edward Elgar Publishing, 1999.

“An Axiomatic Characterization of Common Knowledge,” *Econometrica*, January 1981.

“A Convergence Theorem for Competitive Bidding with Differential Information,” *Econometrica*, May 1979.

“On Understanding the Effects of GAAP Reserve Assumptions,” *Transactions of the Society of Actuaries*, XXVII, 1975.

## **Books**

*Discovering Prices: Auction Design in Markets with Complex Constraints*. Columbia University Press, 2017.

*Putting Auction Theory to Work*. Cambridge: Cambridge University Press, 2004.

## **Contributions to Books and Proceedings**

“Winning Play in Spectrum Auctions,” with Jeremy Bulow and Jonathan Levin, in *Handbook of Spectrum Auction Design*, by Martin Bichler and Jacob Goeree (eds.), Cambridge University Press, 2017.

“Designing the US Incentive Auction,” in *Handbook of Spectrum Auction Design*, by Martin Bichler and Jacob Goeree (eds.), Cambridge University Press, 2017.

“Optimal Incentives in Core-Selecting Auctions,” with Bob Day, in *The Handbook of Market*

*Design*, by Zvika Neeman, Al Roth, and Nir Vulkan (eds.), Oxford University Press, 2013.

“Incentive Auction: Rules and Discussion,” with Lawrence Ausubel, Jonathan Levin and Ilya Segal, published as Appendix C of the FCC 12-118 (Notice of Proposed Rulemaking on the Incentive Auction, Released October 2, 2012).

“Complementarity in Organizations,” with Erik Brynjolfsson, in *The Handbook of Organizational Economics*, by John Roberts and Bob Gibbons (eds.), Princeton University Press, 2012.

“Multipliers and the LeChatelier Principle,” in *Samuelsonian Economics and the Twenty-First Century*, by Michael Szenberg, Lall Ramrattan and Aron Gottesman (eds.), Oxford University Press, 2006.

“The Clock-Proxy Auction: A Practical Combinatorial Design,” with Lawrence M. Ausubel and Peter Cramton, in *Combinatorial Auctions*, by Peter Cramton, Richard Steinberg and Yoav Shoham (eds.), MIT Press, 2005. Reprinted in *Handbook of Spectrum Auction Design*, by Martin Bichler and Jacob Goeree (eds.), Cambridge University Press, 2017.

“Ascending Proxy Auctions,” with Lawrence M. Ausubel, in *Combinatorial Auctions*, by Peter Cramton, Richard Steinberg and Yoav Shoham (eds.), MIT Press, 2005.

“The Lovely but Lonely Vickrey Auction,” with Lawrence M. Ausubel, in *Combinatorial Auctions*, by Peter Cramton, Richard Steinberg and Yoav Shoham (eds.), MIT Press, 2005.

“Competitive Effects of Internet Peering Policies,” with Bridger Mitchell and Padmanabhan Srinagesh, in *The Internet Upheaval*, by Ingo Vogelsang and Benjamin Compaine (eds.), Cambridge: MIT Press, 2000.

“A Theory of Auctions and Competitive Bidding, II,” with Robert Weber, in *The Economic Theory of Auctions*, by Paul Klemperer (ed.), Edward Elgar Publishing, 1999.

“Combination Bidding in Spectrum Auctions,” in *Competition, Regulation and Convergence: Current Trends in Telecommunications Research*, by Sharon Gillett and Ingo Vogelsang (eds.), New Jersey: Lawrence Erlbaum Associates, Publishers, 1999.

“The Internal Politics of the Firm,” with John Roberts, in *The Politics of Exchange and the Economics of Power*, by Samuel Bowles, Maurizio Franzini and Ugo Pagano (eds.), New York: Routledge, 1998.

“Procuring Universal Service: Putting Auction Theory to Work,” in *Le Prix Nobel: The Nobel*

*Prizes, 1996, Nobel Foundation, 1997.*

“Procuring Universal Telephone Service,” in *1997 Industry Economics Conference, Industry Commission (ed.), Conference Proceedings, 1997, AGPS.*

“Complementarities in the Transition from Socialism: A Firm-Level Analysis,” with Susan Gates and John Roberts, in *Reforming Asian Socialism: The Growth of Market Institutions*, by John McMillan and Barry Naughton (eds.), Ann Arbor: University of Michigan Press, 1996.

“Continuous Adjustment and Fundamental Change in Business Strategy and Organization,” with John Roberts, in *Trends in Business Organization: Do Participation and Cooperation Increase Competitiveness?*, by Horst Siebert (ed.), Tübingen: J.C.B. Mohr (Paul Siebeck), 1995.

“Johnson Controls, Inc—Automotive Systems Group: The Georgetown Kentucky Plant,” with John Roberts, *Case #S-BE-9, Stanford Graduate School of Business*, November 1993.

“Is Sympathy an Economic Value? Philosophy, Economics and the Contingent Valuation Method,” in *Contingent Valuation: A Critical Assessment*, by Jerry Hausman (ed.), Elsevier-North Holland, 1993.

“The Real Output of the Stock Exchange,” with Timothy F. Bresnahan and Jonathan Paul, in *Output Measurement in the Services Sectors*, by Zvi Griliches (ed.), 1992.

“Bargaining Costs, Influence Costs and the Organization of Economic Activity,” with John Roberts, in *Perspectives on Positive Political Economy*, by James E. Alt and Kenneth A. Shepsle (eds.), Cambridge: Cambridge University Press, 1990. Reprinted in *Transaction Cost Economics*, by Oliver Williamson and Scott Masten (eds.), London: Edward Elgar Publishing Co., 1994. Reprinted in *The International Library of the New Institutional Economics*, by Claude Ménard (ed.), London: Edward Elgar Publishing, 2003. Reprinted in *The Economic Nature of the Firm*, by Louis Putterman and Randall Kroszner (eds.), Cambridge University Press, 1996. Reprinted in *The International Library of the New Institutional Economics*, by Claude Ménard (ed.), London: Edward Elgar Publishing, 2005.

“New Theories of Predatory Pricing,” with John Roberts, *Industrial Structure in the New Industrial Economics*, by Giacomo Bonanno and Dario Brandolini (eds.), Oxford: Oxford University Press, 1990.

“An Essay on Price Discrimination,” in *The Economics of Imperfect Competition and Employment: Joan Robinson and Beyond*, by George Feiwel (ed.), New York:

MacMillan and New York: New York University Press, 1989.

“Predatory Pricing,” in *The New Palgrave: A Dictionary of Economic Theory and Doctrine*, by J. Eatwell, M. Milgate, and P. Newman (eds.), London: MacMillan Press Ltd., 1988.

“Auction Theory,” in *Advances in Economic Theory: Fifth World Congress*, by Truman Bewley (ed.), London: Cambridge University Press, 1987.

“The Economics of Competitive Bidding: A Selective Survey,” in *Social Goals and Social Organization: A Volume in Honor of Elisha Pazner*, by L. Hurwicz, D. Schmeidler and H. Sonnenschein (eds.), London: Cambridge University Press, 1985.

“Private Information in an Auction-Like Securities Market,” in *Auctions, Bidding and Contracting: Uses and Theory*, by R. Engelbrecht-Wiggans, M. Shubik and R. Stark (eds.), New York: New York University Press, New York, 1983.

“Topologies on Information and Strategies in Normal-Form Games with Incomplete Information,” with Robert Weber, in *Game Theory and Mathematical Economics*, by O. Moeschlin and D. Pallaschke (eds.), New York: North Holland, 1981.

## **Others**

“The Case for Unlicensed Spectrum,” with Jonathan Levin, October 2011.

“Making Carbon Markets Work,” SIEPR, May 2009.

“Using Procurement Auctions to Allocate Broadband Stimulus Grants,” SIEPR, May 2009.

“The Promise of Prediction Markets,” with multiple co-authors, May 2008.

“Economists’ Statement on US Broadband Policy,” with multiple co-authors, March 2006.

“Promoting Efficient Use of Spectrum Through Elimination of Barriers to Secondary Markets,” with multiple co-authors, February 2001.

“An Economist’s Vision of the B-to-B Marketplace,” Palo Alto: Perfect, 2000.

## **Selected Working Papers**

“AI and Market Design,” with Steve Tadelis, January 2018.

“Deferred Acceptance Auctions and Radio Spectrum Reallocation,” with Ilya Segal, September 2017.

“When Should Control Be Shared?” with Eva Meyersson Milgrom and Ravi Singh, April 2007.

**Major Professional Activities and Affiliations**

2016–17	National Academy of Sciences: Class Membership Committee Chair, NAS Temporary Nominating Group
2016	National Academy of Sciences: Air Force Studies Board Committee
2015–present	Editorial Board, Proceedings of the National Academy of Sciences Executive Supervisory Committee, CERGE-EI National Academies’ Intelligence Science and Technology Experts Group (ISTEG)
2012–17	Lead consultant to Federal Communications Commission Incentive Auctions Task Force
2012–14	Editorial Board of European Journal of Pure and Applied Mathematics
2009–present	Editorial Board of AEJ-Microeconomics
2007–08	President, Western Economic Association International (WEAI)
2006–07	Member, National Academy of Sciences President-Elect, Western Economic Association International (WEAI)
2005–06	Vice President, Western Economic Association International (WEAI)
2005–08	Executive Committee of the Econometric Society
2004–06	Council, Econometric Society
2003–present	Council, Game Theory Society
2000–02	Chief economist, Perfect Commerce
1997–02	Editorial Consultant, MIT Press
1997–99	Editorial Board, Journal of Comparative Economics
1996–16	Founder and Director, Market Design Inc. (Chairman, 1996–02)
1996	Nemmers Prize Selection Committee, Northwestern University
1996–06	Advisory Board, Microeconomics Abstracts



1995–05	Advisory Board, Economics Research Network
1994–95	Program Committee, 1995 World Congress of the Econometric Society
1993–95	Senior Research Fellow, Institute for Policy Reform
1993–00	Associate Editor, American Economic Review
1992–present	Fellow, American Academy of Arts and Sciences
1990–93	Co-Editor, American Economic Review
1990–present	Associate Editor, Games and Economic Behavior
1989–92	Associate Editor, Journal of Financial Intermediation
1987–90	Associate Editor, Econometrica
1985–89	Associate Editor, Rand Journal of Economics
1983–87	Associate Editor, Journal of Economic Theory
1984	Chair, Program Committee, Econometric Society Winter Meetings
1984–present	Fellow, Econometric Society
1980–present	Member, American Economic Association

## **Appendix 2**

### **Materials Relied Upon**

#### **Academic Papers**

Aggarwal, Rajesh K., and Guojun Wu. “Stock Market Manipulations.” *Journal of Business* 79, no. 4 (2006): 1915–1953.

Allen, Franklin, and Douglas Gale. “Stock-Price Manipulation.” *Review of Financial Studies* 5, no. 3 (1992): 503–529.

Biais, Bruno, Larry Glosten, and Chester Spatt. “Market Microstructure: A Survey of Microfoundations, Empirical Results, and Policy Implications.” *Journal of Financial Markets* 8, no. 2 (2005): 217–264.

Brunnermeier, Markus K., and Lasse Heje Pedersen. “Market Liquidity and Funding Liquidity.” *Review of Financial Studies* 22, no. 6 (2008): 2201–2238.

Chakraborty, Archishman, and Bilge Yilmaz. “Informed Manipulation.” *Journal of Economic Theory* 114, no. 1 (2004): 132–152.

Easley, David, Nicholas M. Kiefer, Maureen O’Hara, and Joseph B. Paperman. “Liquidity, Information, and Infrequently Traded Stocks.” *Journal of Finance* 51, no. 4 (1996): 1405–1436.

Easley, David, and Maureen O’Hara. “Price, Trade Size, and Information in Securities Markets.” *Journal of Financial Economics* 19, no. 1 (1987): 69–90.

Fleming, Michael J., Bruce Mizrach, and Giang Nguyen, “The Microstructure of a U.S. Treasury ECN: The BrokerTecPlatform.” *Journal of Financial Markets*, forthcoming (2017).

Glosten, Lawrence R., and Lawrence E. Harris. “Estimating the Components of the Bid/Ask Spread.” *Journal of Financial Economics* 21 (1988): 123–142.

Glosten, Lawrence R., and Paul R. Milgrom. “Bid, Ask and Transaction Prices in a Specialist Market with Heterogeneously Informed Traders.” *Journal of Financial Economics* 14, no. 1 (1985): 71–100.

Hasbrouck, Joel. “Measuring the Information Content of Stock Trades.” *Journal of Finance* 46, no. 1 (1991): 179–207.

Huang, Roger D., and Hans R. Stoll. “Dealer Versus Auction Markets: A Paired Comparison of Execution Costs on NASDAQ and the NYSE.” *Journal of Financial Economics* 41, no. 3 (1996): 313–357.

Huang, Roger D., and Hans R. Stoll. “The Components of the Bid-Ask Spread: A General Approach.” *Review of Financial Studies* 10, no. 4 (1997): 995–1034.

Jarrow, Robert A. “Derivative Security Markets, Market Manipulation, and Option Pricing Theory.” *Journal of Financial and Quantitative Analysis* 29, no. 2 (1994): 241–261.

Kraus, Alan, and Hans R. Stoll. “Price Impacts of Block Trading on the New York Stock Exchange,” *Journal of Finance* 27, no. 3 (1972): 569–588.

Kumar, Praveen, and Duane J. Seppi. “Futures Manipulation with ‘Cash Settlement’.” *Journal of Finance* 47, no. 4 (1992): 1485–1502.

Madhavan, Ananth, and Minder Cheng. “In Search of Liquidity: Block Trades in the Upstairs and Downstairs Markets.” *Review of Financial Studies* 10, no. 1 (1997): 175–203.

Pirrong, Craig. “The Economics of Commodity Market Manipulation: A Survey.” *Journal of Commodity Markets* 5, no. 1 (2017): 1–17.

Putnins, Talis J. “Market Manipulation: A Survey.” *Journal of Economic Surveys* 26, no. 5 (2012): 952–967.

Stoll, Hans R. “Friction.” *Journal of Finance* 55, no. 4 (2000): 1479–1514.

## **Books**

Hasbrouck, Joel. *Empirical Market Microstructure: The Institutions, Economics, and Econometrics of Securities Trading*. Oxford: Oxford University Press, 2007.

O’Hara, Maureen. *Market Microstructure Theory*. Cambridge, MA: Blackwell, 1995.

Vives, Xavier. *Information and Learning in Markets: The Impact of Market Microstructure*. Princeton, NJ: Princeton University Press, 2010.

# Exhibit 4

# Appendix C

**UNITED STATES DISTRICT COURT  
NORTHERN DISTRICT OF ILLINOIS  
EASTERN DIVISION**

UNITED STATES OF AMERICA

V.

GREGG SMITH and  
MICHAEL NOWAK,

## Defendants

No. 19 CR 669

**DECLARATION OF KUMAR VENKATARAMAN  
DECEMBER 22, 2022**

## TABLE OF CONTENTS

I.	Introduction .....	1
A.	Qualifications .....	1
B.	Background.....	2
C.	Assignment .....	4
D.	Summary of Conclusions .....	5
II.	Analysis of Market Loss.....	6
A.	Relevant Trading Activity .....	7
B.	Defining Market Harm .....	13
C.	Unadjusted Market Loss Calculation .....	14
D.	Adjustment for But-For Cost of Trading Using a Matched Control Period.....	20
1.	Methodology.....	20
2.	Calculation and Results .....	21
E.	Alternative Adjustment Method: Rate of Spread-Crossing.....	24
1.	Methodology.....	24
2.	Calculation and Results .....	25
F.	Summary of Market Loss Calculations .....	30
G.	Additional Components of Market Loss .....	31

## **I. INTRODUCTION**

### **A. Qualifications**

1. I am a Professor of Finance and hold the Maguire Chair in Energy Management at the Edwin L. Cox School of Business at Southern Methodist University (SMU). I have a Ph.D. degree in Business Administration from Arizona State University, with a major in Finance, and an undergraduate degree in Business Administration (M.M.S.) from the Birla Institute of Technology and Science (BITS-Pilani, India).
2. I served as the Chairman of the Finance Department at SMU between 2012 and 2015. I have taught graduate and undergraduate courses on Financial Management, International Finance, Portfolio Theory, Hedge Funds, Energy Finance and customized finance modules in the Executive Education programs.
3. My research interests lie primarily in the area of market microstructure. I have studied financial market design, measurement of trading cost, evaluation of trading strategies, performance measurement of trading desks and the impact of regulatory reform on financial markets. My research has been published in top-tier academic journals, featured in industry publications, textbooks, and the business press, including the Wall Street Journal, the Economist, Bloomberg News and the Financial Times. I serve on the Editorial Board of several journals.
4. I have presented my research at leading academic conferences, universities, and at regulatory bodies. I served as a member of the U.S. Securities and Exchange Commission's (SEC) Fixed Income Market Structure Advisory Committee between 2017 and 2021. I have served as a visiting economist at Financial Industry Regulatory Authority (FINRA) since



2016 and have previously held a similar position at the Commodity Futures Trading Commission (CFTC). I have received multiple teaching and research awards, including best paper awards at international conferences. Notably, I was named among “The Best 40 B-School Profs Under the Age of 40” in the 2011 Poets & Quants ranking of Business School professors.

5. A copy of my curriculum vitae is included as **Appendix A**.

## B. Background

6. In financial markets, “spoofing” describes the practice of placing an order with the intent to cancel the order before execution. Spoof orders are placed in such a way to create the false appearance of a change in supply or demand, and therefore to trigger a response from other market participants.
7. On August 10, 2022, a federal jury convicted Gregg Smith and Michael Nowak (the “Defendants”) of attempted price manipulation, spoofing, commodities fraud, and wire fraud affecting a financial institution in connection with their trading of precious metals futures contracts on commodities exchanges operated by the CME Group, Inc. (“CME”).
8. Prior to trial, I was engaged by the United States Department of Justice (“DOJ”) to analyze the Defendants’ relevant trading activity. In that capacity, I reviewed trading sequences identified by the DOJ of the Defendants’ trading and the trading of other members of the precious metals desk at JPMorgan Chase Bank, N.A. (“JPMorgan”). I also analyzed the Defendants’ broader trading activity, including submission patterns and execution outcomes of their larger orders and opposite-side smaller orders.

9. At trial, I provided testimony describing how and why certain trading sequences<sup>1</sup> that the DOJ had identified (the “DOJ Episodes”) were not consistent with an economically rational trading strategy aimed at executing the larger, fully displayed orders<sup>2</sup> observed in these sequences. I also testified that the observed trading patterns were consistent with the larger fully displayed orders helping the opposite-side smaller orders obtain executions.<sup>3</sup> I further testified that the Defendants’ broader trading activity in the precious metals futures markets over the period 2008 to 2015<sup>4</sup> was consistent with the patterns observed in the DOJ Episodes. Specifically, the Defendants’ larger, fully displayed orders of certain types and sizes exhibited different order submission patterns and execution outcomes when compared with the Defendants’ smaller orders opposite the larger visible orders.<sup>5</sup>
10. I understand that, at trial, the DOJ introduced evidence that the Defendants and several other members of JPMorgan’s precious metals desk (specifically, Christopher Jordan, John Edmonds, Christian Trunz, and Michel Simonian), executed a four-step spoofing scheme.

---

<sup>1</sup> These DOJ Episodes included 100 trading sequences for defendant Gregg Smith, 100 trading sequences for defendant Michael Nowak, 30 trading sequences for defendant Christopher Jordan, 40 trading sequences for John Edmonds, 55 trading sequences for Christian Trunz, 15 trading sequences for Michel Simonian, 4 trading sequences for Stuart Piller, and 5 trading sequences for Donald Turnbull. I understand that, at trial, the DOJ offered into evidence the trading sequences by the Defendants, Jordan, Edmonds, Trunz, and Simonian (GX 450-455). I also understand that the DOJ offered into evidence at trial trading sequences by Corey Flaum (GX 458), as well as certain trading sequences that corresponded to specific chat communications (GX 463-478, 482, 484), but those trading sequences (*i.e.*, the Flaum and the chat-related sequences) were not within the scope of my analysis.

<sup>2</sup> For many of the sequences, the larger side comprises of groups of small-lot resting, visible orders that in aggregate have a visible order size that is large. A group consists of orders of the same lot size placed on the same side of the market within one second of each other.

<sup>3</sup> See, e.g., Trial Transcript, pp. 2724-2727, 2736, 2738-2740, 2742-2743.

<sup>4</sup> Defendant Michael Nowak’s trading ended in 2014.

<sup>5</sup> See Trial Transcript, pp. 2757-2759, 2761-2765. The smaller orders opposite the larger visible orders include both fully visible orders and iceberg orders. Iceberg orders are limit orders where only a portion of the total order size is visible in the order book at any one time. See Trial Transcript, pp. 2748-2749.

The DOJ presented to the jury numerous specific examples of such sequences,<sup>6</sup> including 100 trading sequences for each of the Defendants, which involved the following steps<sup>7</sup>:

- a. The trader placed one or more smaller limit order(s).
- b. Before or after the trader placed the smaller order(s), the trader placed one or more relatively larger fully-displayed limit orders on the opposite side of the smaller order(s).

The smaller order(s) and the larger orders were active in the market at the same time.

- c. The smaller order(s) received executions while the larger fully-displayed orders were active.
- d. The trader then quickly canceled their larger fully-displayed orders before they were executed in full.

### C. Assignment

11. I have been asked by the DOJ to calculate the amount of loss suffered by other market participants as a result of the Defendants' activity that follows the four-step process described above.<sup>8</sup>
12. In forming my opinion, I relied on my expertise and experience studying financial markets

<sup>6</sup> See Government Exhibits ("GX") 450-455.

<sup>7</sup> For some of the sequences, the larger fully-displayed limit orders were placed before the smaller order on the opposite side of the market was placed. However, the remaining steps in the four-step spoofing scheme remain the same. Further, for some of the sequences, the four-step spoofing scheme starts with a four-step spoofing scheme occurring on one side of the market followed by the same four-step spoofing scheme on the other side of the market, where the quantity executed on the smaller orders are the same. For example, in GX 450, Episode #15 for Gregg Smith, he starts by placing a buy order for 10 contracts, places 70 contracts on the sell side of the market, which is followed by all 10 of his buy order contracts being executed and the subsequent cancelation of all 70 sell side contracts. Then, he places a sell order for 10 contracts, places 90 contracts on the buy side of the market, which is followed by all 10 of his sell order contracts being executed and the subsequent cancelation of all 90 buy side contracts.

<sup>8</sup> Specifically, I have been asked to calculate the losses associated with the Spoofing Sequences summarized in GX 499, which also include Spoofing Sequences for cooperating witnesses John Edmonds and Christian Trunz.

and market microstructure, as well as my analysis of data provided by the CME (the “CME Trading Data”).<sup>9</sup>

#### **D. Summary of Conclusions**

13. Based on my experience studying financial markets and my analysis of the CME Trading Data, I have reached the following conclusions:

- Spoofing distorts the visible supply and demand in the market, which can induce other market participants to raise/lower their bid/offer quotes or to cross the spread to obtain executions when they otherwise would not have absent the spoofing pressure. Therefore, market participants who trade on the same side of the market as a spoof order while the spoof order is active, and at a price that is worse than the prevailing price immediately before the spoof order was placed, are harmed to the extent they were induced to trade by the spoofing pressure.
- In my main approach, the harm to market participants that is attributable to the Defendants’ spoofing activity was determined by comparing the observed cost of trading while the Defendants’ spoof orders were active to the observed “but-for” cost of trading during a control period of equal length immediately before the spoof orders were placed. Implementing such an approach across the Defendants’ approximately 132,265 spoofing sequences results in a total market loss attributable to the spoofing activity of **\$94,774,945**.
- In my alternate approach, the impact of the Defendants’ spoofing activity was measured by comparing the rate at which market participants on the same side as the Defendants’

---

<sup>9</sup> This includes “RAPID,” which provides data for each order message submitted to the CME, and “ARMADA,” which provides data on the state of the market order book over time.

spoof orders crossed the bid-offer spread while the spoof orders were active to the rate of spread crossing in a control period immediately before the spoof orders were placed.

The change in the rate of spread-crossing presents a conservative<sup>10</sup> estimate of the impact of the spoofing pressure on the trading activities of other market participants. Using this conservative approach results in a total market loss attributable to the spoofing activity of **\$55,544,600**.

- Both of these approaches likely understate the true harm to other market participants for reasons described in Section II.G below.

## II. ANALYSIS OF MARKET LOSS

14. In the following sections, I describe my calculation of market loss attributable to the Defendants' spoofing activity using the four-step pattern described at trial. First, I identify the universe of orders that are included in my analysis. I then explain the rationale underlying my approach to measuring market harm, and how the empirical methods that I present capture the incremental impact of the Defendants' spoofing activity and also account for normal market activity that would have otherwise occurred in the absence of the spoofing activity.<sup>11</sup> I conclude with a discussion that highlights why my analysis in all

---

<sup>10</sup> The spread crossing estimate is conservative because the approach accounts for the spoof order's impact on other traders' decision to place aggressively priced orders, but it does not account for inferior prices received by other traders during the Spoofing Sequence (relative to the control period) due to the price impact of spoof orders. As an example, large spoof orders on the buy side could increase the rate at which other traders place aggressively priced orders to buy, and in addition, the spoof order's price impact could move the price higher, thus causing other traders to buy at higher (*i.e.*, inferior) prices during the Spoofing Sequence. The alternate approach accounts for the spoof order's impact on the spread-crossing but not the price impact while the main approach accounts for both the effects.

<sup>11</sup> In this declaration, I follow the same general methodology for calculating market harm that I performed in connection with the sentencings in two recent cases that involved spoofing in the precious metals futures markets, namely, *United States v. Vorley* (18 CR 35), and *United States v. Bases* (18 CR 48). The methodology is tailored to incorporate relevant information and patterns that are particular to the Defendants' spoofing activity.

likelihood understates the true market harm associated with the Defendants' spoofing activity.

#### **A. Relevant Trading Activity**

15. In assessing the market harm attributable to the Defendants' spoofing activity, I have been instructed to limit my analysis to certain trading sequences ("Spoofing Sequences").<sup>12</sup> These Spoofing Sequences are consistent with the four-step spoofing strategy described during trial, with the exception that they also include instances where the spoofing strategy does not result in any executions for the Defendants' smaller orders placed opposite the Defendants' large, fully displayed orders (*i.e.*, "unsuccessful" spoofing sequences). In other words, while the conduct described by the DOJ's witnesses at trial was focused on instances where the spoof orders directly benefited the Defendants by successfully triggering executions on their smaller orders, the Spoofing Sequences here also include spoof orders that caused harm to the rest of the market even though they did not directly benefit the Defendants' smaller orders.
16. More specifically, the Spoofing Sequences are identified from the Defendants' and cooperating witnesses' trading activity for the following time periods that reflect the window over which the DOJ episodes shown at trial occurred:
  - Defendant Gregg Smith from January 4, 2008 to April 17, 2015 for gold, silver, and palladium;

---

<sup>12</sup> Specifically, I have been asked by the DOJ to limit my analysis to the Spoofing Sequences summarized in GX 499 and then further limit my analysis to Spoofing Sequences with aggregate quantity of the large, fully displayed orders of at least 30, 15, 20, and 20 contracts for gold, silver, platinum, and palladium, respectively. I further limited the analysis to Spoofing Sequences where the duration of large, fully displayed layers of the Spoofing Sequence was within the 99<sup>th</sup> percentile (82.3 seconds) of the duration distribution.

- Defendant Michael Nowak from June 18, 2009 to February 7, 2014 for gold;
- Cooperating witness Christian Trunz from April 29, 2008 to June 8, 2016 for gold, silver, platinum, and palladium; and
- Cooperating witness John Edmonds from August 3, 2009 to March 5, 2014 for gold, silver, platinum, and palladium.

The Spoofing Sequences meet the following parameters:

- A Spoofing Sequence includes both a resting, fully displayed group<sup>13</sup> of orders (“Spoof Orders”) that are placed by a Defendant or cooperating witness on one side of the market and smaller limit order(s) on the opposite side of the market (“Opposite Orders”).
- Spoof Orders must be resting orders placed in groups within the top ten levels of the order book<sup>14</sup> and for the same lot sizes placed by that trader in the DOJ Episodes.<sup>15</sup>
- Opposite Orders must be placed within the top ten levels of the order book.<sup>16</sup>

---

<sup>13</sup> A group of orders is defined as orders of the same lot size placed on the same side of the market within one second of each other. A group consists of at least two orders.

<sup>14</sup> Or, for dates on which the CME’s ARMADA data is not available, within nine ticks of the best market price estimated using CME’s RAPID data. Or, for dates on which only the top five levels are available in CME’s ARMADA data, within 5 ticks of the fifth best market price in CME’s ARMADA data.

<sup>15</sup> For Defendant Gregg Smith, Spoof Orders are limited to orders of 7-lot and 10-lot groups for gold and 10-lot groups for silver and palladium. For Defendant Michael Nowak, Spoof Orders are limited to orders of 5-lot and 10-lot groups for gold. For cooperating witness Christian Trunz, Spoof Orders are limited to orders of 5-lot and 10-lot groups from gold and silver and 5-lot groups for palladium and platinum. For cooperating witness John Edmonds, the Spoof Orders are limited to orders of 2-lot, 4-lot, and 10-lot groups for gold, 2-lot, 3-lot, 4-lot, 5-lot, and 10-lot for silver, and 10-lot groups for palladium, and 2-lot groups for platinum.

<sup>16</sup> Or, for dates on which the CME’s ARMADA data is not available, within nine ticks of the best market price estimated using CME’s RAPID data. Or, for dates on which only the top five levels are available in CME’s ARMADA data, within 5 ticks of the fifth best market price in CME’s ARMADA data.

- For Spoofing Sequences with groups of fully displayed limit orders on both sides of the market, I require that the large side aggregate quantity is at least twice as large as the small side aggregate quantity.<sup>17</sup>

17. These Spoofing Sequences include instances where more than one trader had Spoof Orders active on the same side of the market at the same time. When this occurs, I treat Spoof Orders from multiple traders that overlap in time with each other as a single Spoofing Sequence. The table below summarizes the number of Spoofing Sequences that include Spoof Orders from multiple traders. Overall, and as summarized in the table below, I identified 132,265 Spoofing Sequences<sup>18</sup> comprising over 1,383,712 individual Spoof Orders whose aggregate notional value at placement equals approximately \$1.52 trillion.

---

<sup>17</sup> An Opposite Order can include groups of resting fully-visible orders.

<sup>18</sup> I treat Spoof Orders that overlap in time with each other as a single Spoofing Sequence, and Spoof Orders that do not overlap in time with each other as separate Spoofing Sequences (including when the separate Spoofing Sequences overlap with the same Opposite Orders).



Trader	Number of Spoofing Sequences	Number of Spoof Orders	Notional Value of Spoof Orders (Billions)
Gregg Smith	105,890	1,027,910	\$1,227.60
Christian Trunz	17,753	219,797	\$175.42
Michael Nowak	5,950	85,873	\$91.20
John Edmonds	2,504	45,216	\$24.86
Gregg Smith & Michael Nowak	94	2,808	\$3.32
Gregg Smith & Christian Trunz	49	1,246	\$1.45
Michael Nowak & Christian Trunz	15	569	\$0.49
Gregg Smith & John Edmonds	4	126	\$0.11
Michael Nowak & John Edmonds	4	111	\$0.08
John Edmonds & Christian Trunz	2	56	\$0.04
<b>Total</b>	<b>132,265</b>	<b>1,383,712</b>	<b>\$1,524.58</b>

18. Of the identified Spoofing Sequences, the majority appear in the gold futures market, as shown in the following table:

<b>Spoof Orders</b>					
<b>Trader</b>	<b>Gold Futures</b>	<b>Silver Futures</b>	<b>Palladium Futures</b>	<b>Platinum Futures</b>	<b>Total Precious Metals</b>
Gregg Smith	973,003	54,125		782	1,027,910
Christian Trunz	165,108	53,494	603	592	219,797
Michael Nowak	85,873				85,873
John Edmonds	29,605	15,030	210	371	45,216
Gregg Smith & Michael Nowak	2,808				2,808
Gregg Smith & Christian Trunz	1,140	106			1,246
Michael Nowak & Christian Trunz	569				569
Gregg Smith & John Edmonds	126				126
Michael Nowak & John Edmonds	111				111
John Edmonds & Christian Trunz		56			56
<b>Total</b>	<b>1,258,343</b>	<b>122,811</b>	<b>813</b>	<b>1,745</b>	<b>1,383,712</b>

19. The Spoof Orders that comprise these Spoofing Sequences exhibit certain characteristics, such as large aggregate visible quantity, short duration, and resulting low fill ratios that are inconsistent with a strategy aimed at executing trades on these orders. First, the total aggregate number of visible Spoof Order contracts placed in a Spoofing Sequence is, on average, larger than the total average visible liquidity in the market available in the top five levels of the order book prior to the placement of Spoof Orders, as shown in the table below.<sup>19</sup> Thus, the placement of Spoof Orders significantly changes the imbalance in the visible order book.

<sup>19</sup> As shown in GX 499, on average the market liquidity in the top 5 levels of the visible order book on the Spoof Order side of the market prior to the placement of the Defendants' Spoof Orders is 56 contracts.

Trader	Average of Total Visible Spoof Order Contracts
Gregg Smith	69
Christian Trunz	58
Michael Nowak	67
John Edmonds	77
Average Visible Market Liquidity Before Spoof Orders Placed in GX 499	56

20. Second, the Spoof Orders exhibit short order durations in comparison to the duration of the Opposite Orders. The median duration of Spoof Orders is only 1.5 seconds compared to 12.8 seconds for Opposite Orders. Third, the Spoof Orders exhibit lower execution ratios in comparison to Opposite Orders. The fill ratio, or percentage of total contracts ordered that were executed, is only 2.6% for Spoof Orders compared to 40.1% for Opposite Orders.

Order Type	Number of Orders	Median Duration (Seconds)	Fill Ratio
Spoof Orders	1,383,712	1.5	2.6%
Opposite Orders	203,181	12.8	40.1%

21. Finally, I also observed that more than two-thirds (68%) of Mr. Smith's Spoof Orders consisted of groups of 10-lot orders while the remaining consisted of groups of 7-lot orders. Over half (56%) of Mr. Nowak's Spoof Orders consisted of groups of 5-lot orders and the remaining consisted of groups of 10-lot orders. These order sizes and cancelation characteristics of the Spoof Orders are consistent with the analysis of the Defendants' broader trading activity I discussed during trial.<sup>20</sup>

<sup>20</sup> See, e.g., Trial Transcript, pp. 2761-2765.

22. My analysis of the data confirms that the Spoofing Sequence selection criteria described above identify activity that, in my view, is inconsistent with an economically rational trading strategy aimed at obtaining fills for the identified Spoof Orders. Furthermore, the requirement that Spoof Orders be at least a certain aggregate number of contracts, fully displayed, and placed within the top ten levels of the order book ensures that these orders conveyed meaningful new information to other market participants, and the removal of sequences with groups of fully-displayed orders on the Opposite Side that are half the size (or larger) of the aggregate quantity on the Spoof Order Side ensures that the Defendants' trading activity created a visible order book imbalance to which market participants would be expected to react.

## **B. Defining Market Harm**

23. In order to quantify the harm caused by the Defendants' Spoof Orders, I first identify transactions that occurred while the Spoof Orders were active in the visible order book.<sup>21</sup> My objective is to calculate losses incurred by market participants who bought while the Defendants' Spoof Orders to buy were active (which increased the perception of buying interest) and participants who sold while Defendants' Spoof Orders to sell were active

---

<sup>21</sup> Some Spoof Orders moved outside of the visible order book (*i.e.*, the first ten levels of the order book) as the market price moved away. For buy side Spoof Orders, I determine the maximum price of all layers placed in a layering group, and for sell side Spoof Orders, I determine the minimum price of all layers placed in a layering group. I compare this price to the visible order book and determine the time that the price would no longer be in the visible order book. For dates on which the CME's ARMADA data is not available, I determine the time that the price would no longer be within nine ticks of the best market price estimated using CME's RAPID data. For dates on which only the top five levels are available in CME's ARMADA data, I determine the time that the price would no longer be within five ticks of the fifth best market price in CME's ARMADA data. I only consider transactions that occur until Spoof Orders first move outside of the visible order book. Relatedly, I do not consider transactions when Spoof Orders move outside of the visible order book and subsequently reappear in the first ten levels of the order book.

(which increased the perception of selling interest).<sup>22</sup>

24. Spoof Orders distort the visible buying and selling interest in the market. They can induce other traders to raise/lower their bid/offer price quotes or to cross the bid-offer spread when they otherwise would not have. For example, Spoof Orders placed on the buy side of the order book in the gold futures market create an artificial perception of buying interest and signal the likelihood that the gold futures price will rise in the future. The additional perceived buying pressure induces other market participants to raise the prices at which they are willing to buy and/or induces them to cross the bid-offer spread and accept the current best offer price, or even higher prices, in an attempt to buy quickly before the anticipated rise in the price of gold. The market participants who bought in reaction to artificial buying pressure created by the Spoof Orders are therefore harmed to the extent the Spoof Orders induced them to participate at a worse price than they would have otherwise. The Defendants correspondingly benefitted from artificial buying interest created by their Spoof Orders, because the incidences of market participants crossing the bid-offer spread increased the fill probability of the Defendants' Opposite Orders, beyond what the Defendants otherwise would have been able to fill had they not placed Spoof Orders.

### **C. Unadjusted Market Loss Calculation**

25. In order to calculate the loss incurred by market participants on the Spoof Order side of transactions, I compare the price at which market participants traded to the price at which

---

<sup>22</sup> As I discuss later, while the Spoof Orders may have had a lasting impact on market dynamics even after they were canceled, my analysis only considers the impact while the Spoof Orders were active. This is one respect in which my analysis likely understates the true effect of the Spoof Orders.

they would have been able to trade in the absence of the Defendants' Spoof Orders ("But-For Trade Prices"). The best available indicators of But-For Trade Prices are the last observed bid and offer prices immediately before the placement of the first Spoof Order in each Spoofing Sequence. The But-For Trade Price is therefore the last observed best bid price for buy-side Spoof Orders and the last observed best offer price for sell-side Spoof Orders.<sup>23</sup>

26. For each transaction that occurred while the Spoof Orders were active, I calculate the difference between the price at which the execution actually occurred ("Actual Trade Price") and the corresponding But-For Trade Price. This price difference is a measure of the additional mark-up, or the higher cost (or potentially, benefit) of trading for market participants on the Spoof Order side of the transaction while the Spoof Orders were active. Specifically, when the Actual Trade Price is "worse" (*i.e.*, higher for buyers and lower for sellers) than the But-For Trade Price, the participants incurred a higher cost relative to the state of the market before the Spoof Order was placed. Conversely, when the Actual Trade Price is "better" (*i.e.*, lower for buyers and higher for sellers) than the But-For Trade Price, the participants recognized a benefit. To arrive at the "Unadjusted Market Loss"<sup>24</sup> associated with an individual transaction, I multiply the price differential by the transacted quantity. I aggregate this measure across all transactions executed by market participants

---

<sup>23</sup> For a trader interested in buying prior to a spoof, the last observed bid price immediately before the placement of the spoof orders, which reflects the highest purchase price among buying interest expressed in the visible book, is a reasonable estimate of the But-For Trade Price for the trader, absent the spoof. Along similar lines, for a trader interested in selling prior to the spoof, the last observed offer price immediately before the placement of the spoof orders, which reflects the lowest sale price among selling interest expressed in the visible book, is a reasonable estimate of the But-For Trade Price for the trader, absent the spoof.

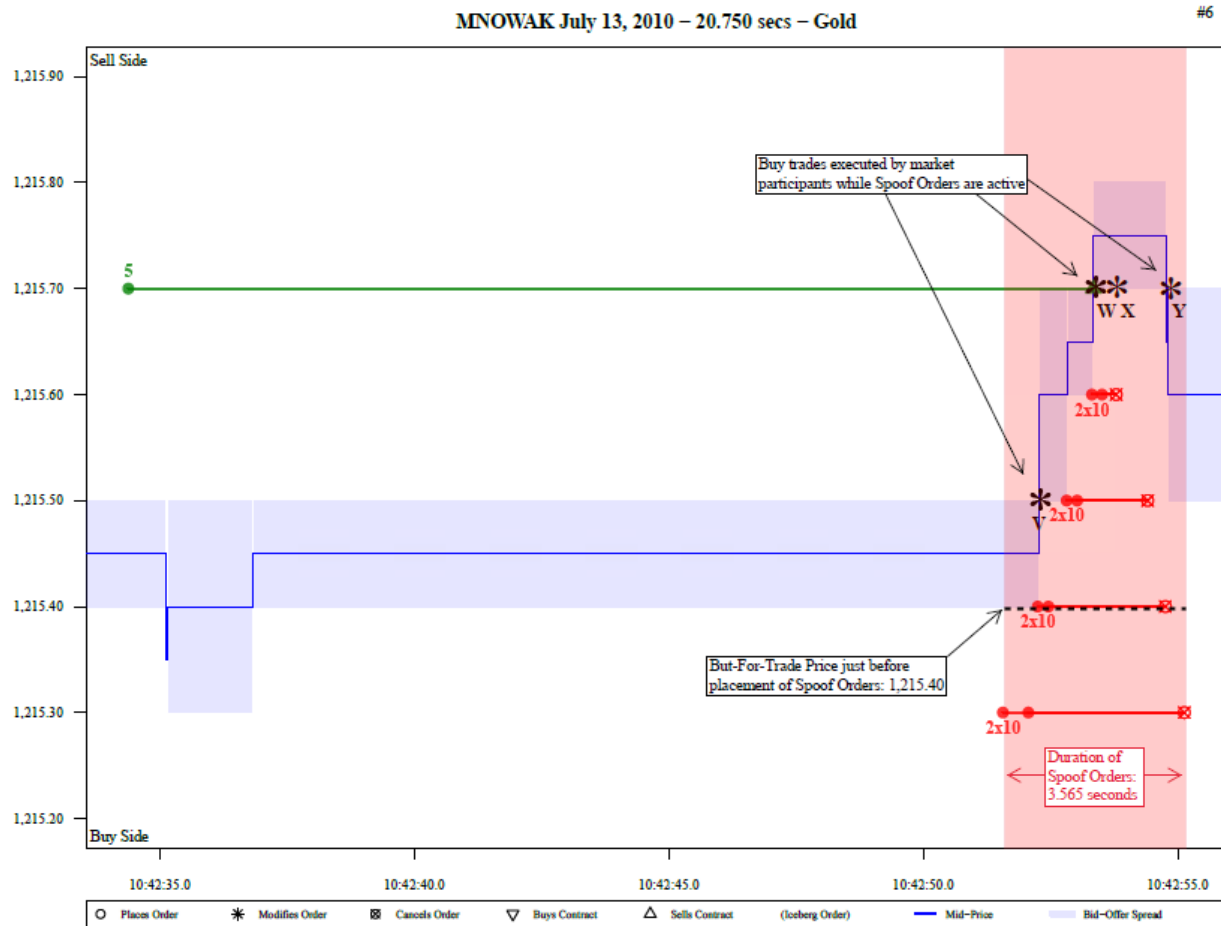
<sup>24</sup> In the unadjusted analysis, I assume that market participants on the Spoof Order side would all have otherwise traded at the But-For Trade Price. In subsequent sections of this declaration, I modify the Unadjusted Market Loss to account for the trading that occurs in normal market conditions (*i.e.*, without Spoof Orders).

while Spoof Orders are active to arrive at a total Unadjusted Market Loss estimate across all Spoofing Sequences.<sup>25</sup>

27. To illustrate this calculation, consider Episode #6 for Michael Nowak from the 100 episodes in GX 451, an episode with a group of 10-lot Spoof Orders placed by Mr. Nowak on the buy side. Immediately before the Spoof Orders are placed, the prevailing best bid price is \$1,215.40. Therefore, for this episode, the But-For Trade Price is \$1,215.40. On the chart below, I have marked with an asterisk the executed trades during the pendency of the Spoof Order:

---

<sup>25</sup> In some cases, a transaction might occur when multiple Spoof Orders are active. The Unadjusted Market Loss associated with an individual transaction is counted only once, even when the transaction occurs while multiple Spoof Orders are active.



- Market participant V crosses the bid-offer spread observed prior to the spoof placement to buy one contract (100 ounces) at an Actual Trade Price of \$1,215.50 per ounce at 10:42:52.266 AM. The Unadjusted Market Loss for this trade is therefore calculated as:  $(\$1,215.50 - \$1,215.40) \times 100 = \$10$ .
- Market participant W crosses the bid-offer spread to buy five contracts (500 ounces) at an Actual Trade Price of \$1,215.70 per ounce at 10:42:53.344 AM and buys five additional contracts (500 ounces) from Mr. Nowak at an Actual Trade Price of \$1,215.70 per ounce at 10:42:53.344 AM. I note that the pattern of price movement is consistent with spoof orders exerting price pressure that raises the bid and offer prices.



The Unadjusted Market Loss for these trades is therefore calculated as:  $(\$1,215.70 - \$1,215.40) \times 1,000 = \$300$ .

- Market participant X crosses the bid-offer spread observed prior to the spoof placement to buy one contract (100 ounces) at an Actual Trade Price of \$1,215.70 per ounce at 10:42:53.805 AM. The Unadjusted Market Loss for this trade is therefore calculated as:  $(\$1,215.70 - \$1,215.40) \times 100 = \$30$ .
- Market participant Y crosses the bid-offer spread to buy one contract (100 ounces) at an Actual Trade Price of \$1,215.70 per ounce at 10:42:54.774 AM. The Unadjusted Market Loss for this trade is therefore calculated as:  $(\$1,215.70 - \$1,215.40) \times 100 = \$30$ .

28. Across all Spoofing Sequences, the total Unadjusted Market Loss for market participants on the Spoof Order side based on all transactions observed while the Spoof Orders are active is \$119,609,715.<sup>26</sup> These market participants include 53,338 unique traders trading through 808 unique firms.<sup>27</sup> Across the Spoofing Sequences, the median duration of the layering group of the Spoof Orders is 2.9 seconds, the 75<sup>th</sup> percentile of the layering group duration distribution is 5.1 seconds, and the 90<sup>th</sup> percentile of the layering group duration distribution is 10.7 seconds. If I limit the loss calculation to trades that occur when the Spoof Orders layering groups are active, and in the case of the longer Spoofing Sequences to trades that occur within 5 seconds after the placement of the first Spoof Order in the

<sup>26</sup> This aggregate figure includes instances where the resulting market loss calculation is negative, *i.e.*, where the Actual Trade Price is “better” than the But-For Trade Price. Including only trades that are executed at a worse price than the But-For Trade Price would increase the aggregate unadjusted market loss by approximately \$5,273,980.

<sup>27</sup> I determined the number of unique traders using the “tag 50” variable in the CME Trading Data. I understand that the tag 50 represents each trader’s unique operator ID. *See* Trial Transcript, pp. 817. I determined the number of unique firms using the “firm” variable in the CME Trading Data.

Spoofing Sequence, the total Unadjusted Market Loss for market participants on the Spoof Order side is \$60,280,320. If I limit the loss calculation to trades that occur when the Spoof Orders layering groups are active, and in the case of the longer Spoofing Sequences to trades that occur within 30 seconds after the placement of the first Spoof Order in the Spoofing Sequence, the total Unadjusted Market Loss for market participants on the Spoof Order side is \$107,350,120. That is, in effect, if I limit the duration of longer Spoof Order Sequences to 30 seconds, I still find magnitudes that account for 94% of overall trades and 90% of the overall Unadjusted Market Losses.

	<b>Unadjusted Market Loss</b>	<b>Number of Affected Contracts Traded by Market Participants</b>	<b>Unique Traders Affected</b>	<b>Unique Firms Affected</b>
Trades during the Spoof Duration	\$119,609,715	4,031,813	53,338	808
Trades within the minimum of [Spoof Duration, 30 seconds]	\$107,350,120	3,801,596	51,923	808
Trades within the minimum of [Spoof Duration, 10 seconds]	\$80,814,885	3,175,062	47,433	789
Trades within the minimum of [Spoof Duration, 5 seconds]	\$60,280,320	2,618,829	42,775	771

29. I term this measure of market loss incurred by market participants as “unadjusted” because it does not account for the fact that some participants may have been willing to increase/decrease their order’s limit price or cross the bid-offer spread to trade at a worse price even in the absence of Spoof Orders. In the next sections, I present two approaches that account for these scenarios and adjust my calculation of the market loss.

## **D. Adjustment for But-For Cost of Trading Using a Matched Control Period**

### *1. Methodology*

30. One way to qualify the Unadjusted Market Loss is to recognize that, even absent pressure from Spoof Orders, not every market participant would have alternatively traded at the But-For Trade Prices. Rather, some market participants may choose to cross the spread anyway to trade at a worse price, thereby incurring a mark-up, or a higher cost of trading, in exchange for immediate execution. Best prices may also move absent Spoof Order pressure, even within a short period of time, and generate additional cost of trading for the market participant, where the “cost” of trading is positive when the price moves in an unfavorable direction and negative when the price moves in a favorable direction.
31. I present an event study methodology to estimate the “Adjusted Market Loss” that is attributable to the Defendants’ Spoof Orders.<sup>28</sup> For each Spoofing Sequence, the methodology identifies a matched control period of trading and estimates a But-For cost of trading for market participants on the Spoof Order side for trades observed in the control period. The But-For cost of trading in the matched control period is deducted from the Unadjusted Market Loss I calculated above for the Spoofing Sequences. The remaining amount is the “Adjusted Market Loss” and represents the abnormal cost of trading that is attributable to the Defendants’ Spoof Orders. I describe this calculation in more detail in the following paragraphs.

---

<sup>28</sup> Sarkar and Schwartz (2009, Journal of Finance) and Baruch, Panayides and Venkataraman (2017, Journal of Financial Economics) illustrate general event study methodology for trading patterns. Beschwiz, Keim and Massa (2020, Review of Asset Pricing Studies) provide an example of intraday implementation, showing that the market reacts to false information signals, with the reaction concentrated in the first five seconds after the false signal.

## 2. *Calculation and Results*

32. For each Spoofing Sequence, I identify a matched control period of the same length as the duration of the Spoof Orders in the visible order book,<sup>29</sup> and that immediately precedes the placement of the Spoof Orders.
33. For the control period for each Spoofing Sequence, I calculate the cost of trading for market participants on the Spoof Order side using an identical approach that I described for the Unadjusted Market Loss for the Spoofing Sequence. Specifically, I identify all transactions that occurred during the control period, and for each transaction, I calculate the difference between the price at which the trade actually occurred (*i.e.*, the Actual Trade Price) and the corresponding But-For Trade Price for the control period. The But-For Trade Price for the control period is the best price available immediately prior to the control period – the last observed best bid price for buy-side Spoofing Sequences and the last observed best offer price for sell-side Spoofing Sequences.<sup>30</sup> For instance, in the case of a buy-side Spoofing Sequence, I calculate the difference between the prices at which market participants transacted during the control period (*i.e.*, Actual Trade Prices) and the best bid price available immediately prior to the control period (*i.e.*, But-For Trade Price). To arrive at the But-For cost of trading associated with an individual transaction during the control period, I multiply the price differential by the transacted quantity. Across all Spoofing

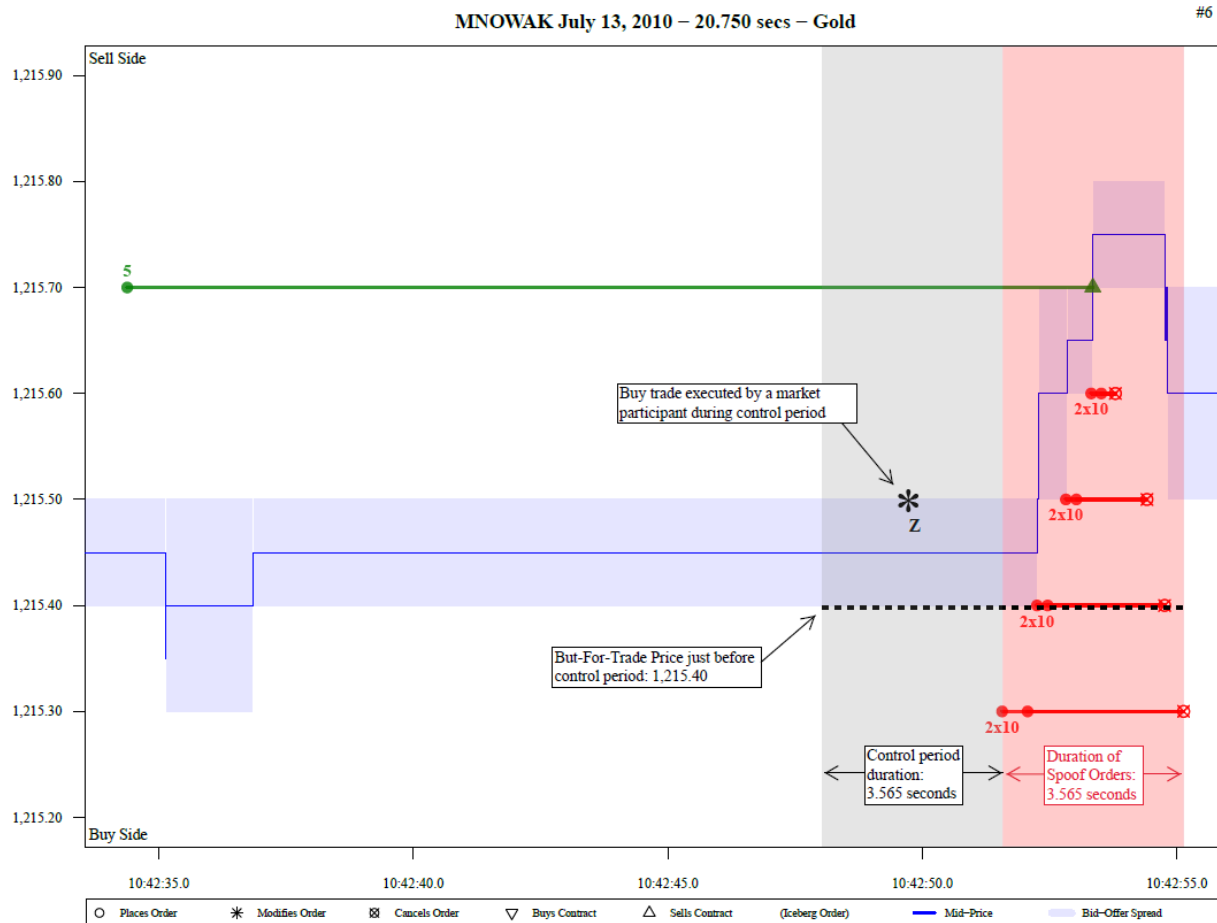
---

<sup>29</sup> The Spoof Order remains visible in the order book until it is either canceled, fully filled, or the market price moves such that all the resting Spoof Orders in the Spoofing Sequence are no longer in the first ten levels of the order book.

<sup>30</sup> For roughly 15% of Spoofing Sequences, a preceding control period that has the same duration as the Spoof Orders is not possible because the control period would overlap with a previous Spoofing Sequence. In these situations, I calculate the cost of trading during this abbreviated control period, and then scale it up proportionally to match the duration of the Spoof Orders. For example, if the duration of the Spoof Orders in a Spoofing Sequence is 5 seconds, but the preceding control period is only 2 seconds until it overlaps with a prior Spoofing Sequence, I multiply the But-For cost of trading that I calculate for the control period by 2.5 ( $= 5 \div 2$ ).

Sequences, I then calculate the total But-For cost of trading during the control periods by aggregating the cost across all transactions executed by market participants during the control periods.

34. Since the control period immediately precedes the placement of the Spoof Orders in a Spoofing Sequence, the methodology accounts for idiosyncratic market conditions that may differ across Spoofing Sequences and provides an estimate of the “normal” cost of trading of market participants around the time of a Spoofing Sequence, absent the placement of the Spoof Orders. To obtain an Adjusted Market Loss estimate, I calculate the difference between the total Unadjusted Market Loss of the Spoofing Sequences and the total But-For cost of trading during the control period. This measure accounts for both the prevailing market conditions and the normal trading behavior of market participants absent any spoofing activity.
35. To illustrate this calculation, I return to Episode #6 for Michael Nowak. In this episode, the first Spoof Order in the group is placed at 10:42:51.562 AM and the group of Spoof Orders has a duration of 3.565 seconds, so the control period with matching duration for this episode is 3.565 seconds and begins at 10:42:47.997 AM and ends at 10:42:51.562 AM, the same time that the first Spoof Order is placed. Immediately before the start of the control period, the prevailing best bid price is \$1,215.40, so the But-For Trade Price for this control period is \$1,215.40. During the control period, one market participant fills an order to buy (marked on the chart below with an asterisk):



- Market participant Z crosses the bid-offer spread to execute a buy order for one contract (100 ounces) at an Actual Trade Price of \$1,215.50 per ounce at 10:42:49.404 AM. The control period But-For cost of trading for this trade is therefore calculated as:  

$$(\$1,215.50 - \$1,215.40) \times 100 = \$10.$$

36. Across all the identified Spoofing Sequences, the But-For cost of trading during the control periods adds up to \$24,834,770. Deducting this cost of trading from the total Unadjusted Market Loss results in a total Adjusted Market Loss of \$94,774,945, as shown in the table

below.<sup>31</sup> The table below also shows the Adjusted Market Loss when I restrict my analysis in the case of the longer Spoof Order Sequences to trades that occur during a short duration after the placement of Defendants' Spoof Orders. Even were I to restrict my analysis to only the first five seconds after the Spoof Order placement, the Adjusted Market Loss is over \$37,075,553.

	Unadjusted Market Loss [A]	But-For Cost of Trading matched control [B]	Adjusted Market Loss [C]=[A]-[B]
Trades during the Spoof Duration	\$119,609,715	\$24,834,770	\$94,774,945
Trades within the minimum of [Spoof Duration, 30 seconds]	\$107,350,120	\$25,962,783	\$81,387,337
Trades within the minimum of [Spoof Duration, 10 seconds]	\$80,814,885	\$27,065,895	\$53,748,990
Trades within the minimum of [Spoof Duration, 5 seconds]	\$60,280,320	\$23,204,767	\$37,075,553

37. The above describes the main approach, which adjusts for the But-For cost of trading using a matched control period. In the next section, I discuss an alternative approach, which presents a conservative estimate of the Adjusted Market Loss.

#### **E. Alternative Adjustment Method: Rate of Spread-Crossing**

##### *1. Methodology*

38. Market participants incur trading costs primarily when they cross the bid-offer spread to trade. For example, a market participant who intends to buy gold futures contracts could

<sup>31</sup> This includes instances of Spoofing Sequences where the cost of trading in the control period exceeds the Unadjusted Market Loss, resulting in a negative Adjusted Market Loss for the given Spoofing Sequence.

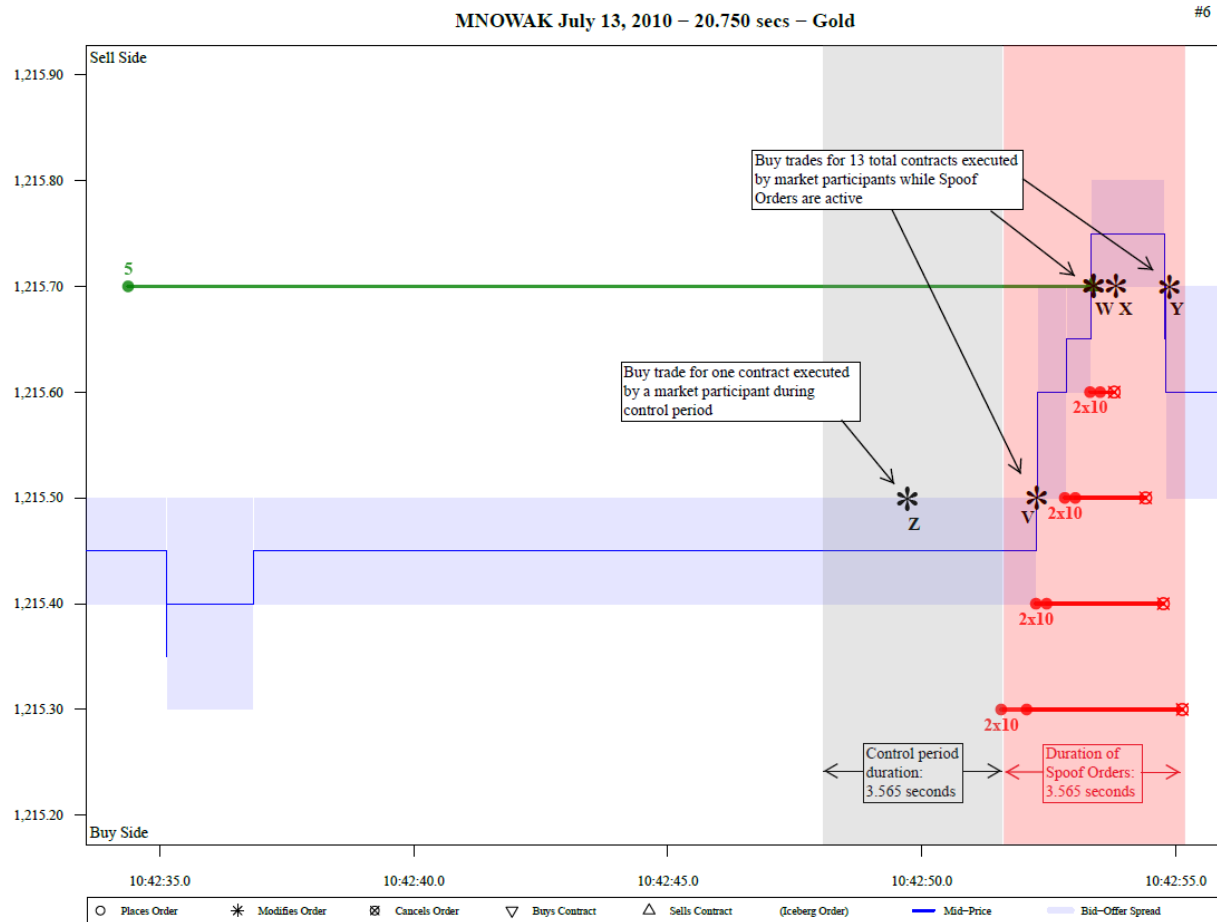
place a resting limit order at the best bid. By crossing the spread to trade at the best offer, which is at a higher price, this market participant incurs a cost. As explained earlier, spoofing, and the misleading appearance of supply/demand it introduces, can induce market participants to cross the spread and incur the associated costs.

39. Under typical market conditions, some market participants will decide to cross the spread to trade, even absent any pressure from spoofing activity. In other words, among the spread-crossing trades that take place while the Spoof Orders are active, some would have occurred anyway even in the absence of Spoof Orders. I make an adjustment for the spread-crossing trades that would have occurred anyway by comparing the rates of spread-crossing during the Spoofing Sequence and during a similar-duration control period. This approach provides another metric by which I can adjust the Unadjusted Market Loss to remove the trading costs that market participants would have likely incurred absent the Spoof Orders. I refer to this as the Alternative Adjusted Market Loss.

## 2. *Calculation and Results*

40. I calculate the “rate of spread-crossing” as the per-second number of contracts traded by market participants on the Spoof Order side who crossed the spread. I compare the spread-crossing rate during a control period immediately prior to the Spoofing Sequence to the spread-crossing rate during the Spoofing Sequence to measure the impact of the Spoof Orders on spread crossing activity.



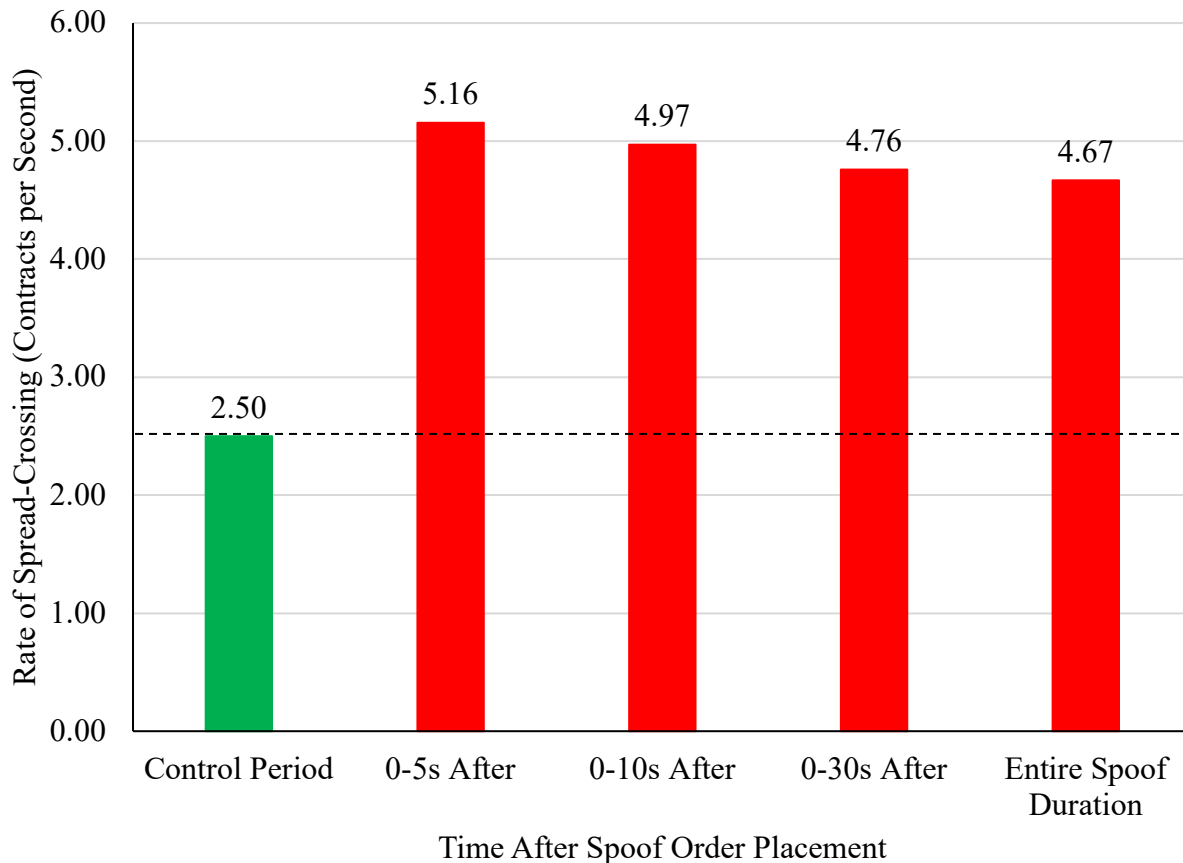


41. To illustrate this calculation, I return to Episode #6 for Michael Nowak, an episode with a group of 10-lot Spoof Orders placed by Mr. Nowak on the buy side. Immediately before the Spoof Orders are placed, the prevailing best bid price is \$1,215.40. During the Spoofing episode, Market participants V, W, X and Y cross the prevailing bid-offer spread to buy one contract, ten contracts, one contract, and one contract, respectively. The rate of spread-crossing during the Spoofing Sequence is 3.65 contracts per second (13 contracts divided by 3.565 seconds). In the control period with matching duration for this Spoofing Sequence, Market participant Z crosses the bid-offer spread to buy one contract. The rate of spread-crossing during the control period is 0.28 contracts per second (1 contract divided by 3.565 seconds).

42. Across all Spoofing Sequences, I calculate the spread-crossing rate for the Spoofing Sequence and for similar-duration control period immediately preceding the placement of the Spoof Orders. I aggregate and present the results in the figure below. This figure shows that, compared to the control period before the placement of the Spoof Orders, the rate of spread-crossing for orders on the Spoof Order side during the duration of Spoofing Sequences is almost twice as large (4.67 contracts per second versus 2.5 contracts per second). This figure also shows that, compared to the control period before the placement of the Spoof Orders, the rate of spread-crossing for orders on the Spoof Order side increases in the first five seconds after the Spoof Orders are placed and remains elevated for the duration of the Spoof Orders.<sup>32</sup>

---

<sup>32</sup> The 75<sup>th</sup> percentile of the layering group duration distribution is 5.1 seconds, and the 90<sup>th</sup> percentile of the layering group duration distribution is 10.7 seconds. For example, the “0-5s After” analysis is based on the actual duration for about three-quarters of the Spoofing Sequences sample and a five-second period for the remaining one-quarter of the sample.



43. The difference between the elevated rate of spread-crossing during the Spoofing Sequences and the normal rate of spread-crossing observed during the control period can then be reasonably attributed to the placement of the Spoof Orders. I therefore remove the portion represented by the normal rate of spread-crossing from the Unadjusted Market Loss to arrive at a measure of the Alternative Adjusted Market Loss.
44. As shown in the figure above and the table below, during the control period before the Spoof Orders are placed, an average of 2.50 contracts per second are traded by market participants on the Spoof Order side who crossed the spread. When Spoof Orders are active, the spread-crossing rate increases to 4.67 contracts per second. Therefore, I estimate that approximately  $2.50 \div 4.67 = 53.6\%$  of the spread-crossing contracts traded by

participants on the Spoof Order side while the Spoof Orders are active would reasonably have occurred in the absence of the spoofing activity. Discounting the \$119,609,715 Unadjusted Market Loss by 53.6% yields approximately \$55,544,600 for the Alternative Adjusted Market Loss.

45. The figure above and table below also show that the spread-crossing rate is highest in the seconds immediately after the Spoof Orders were placed, jumping from 2.50 contracts per second in the control period before the Spoof Orders were placed to 5.16 contracts per second in the five seconds immediately after the Spoof Orders were placed.

	Unadjusted Market Loss [A]	Rate of Spread-Crossing (Contracts per Second) [B]	Percentage Adjustment [C] = [X] / [B]	Adjusted Market Loss [D] = [A] x (1 - [C])
[X] Control Period		2.50		
During the Spoof Duration	\$119,609,715	4.67***	53.6%	\$55,544,600
Limit to the minimum of [Spoof Duration, 30 seconds]	\$107,350,120	4.76***	52.5%	\$50,955,183
Limit to the minimum of [Spoof Duration, 10 seconds]	\$80,814,885	4.97***	50.3%	\$40,162,883
Limit to the minimum of [Spoof Duration, 5 seconds]	\$60,280,320	5.16***	48.5%	\$31,047,889

\*\*\* Denotes statistically significant in difference from Control Period at a 99.99% confidence level.

Note: [D] is based on a more precise percentage adjustment than is reported in [C].

46. The spread-crossing method provides a conservative estimate of the Adjusted Market Loss. This is because the method only accounts for other traders' decision to cross the spread at a higher rate during the Spoofing Sequence. Notably it does not account for the inferior prices received by other traders during the Spoofing Sequence relative to the control period due to the price impact of the Spoof Orders.
47. Additionally, I tested the difference between spread-crossing rates before and after the

Spoof Order placement using a pair-wise t-test.<sup>33</sup> I find that the difference between the spread-crossing rates is statistically significant with a confidence level of over 99.99%. This statistical test confirms that the increase in the rate of spread-crossing estimated for the Spoofing Sequences relative to the control period is not due to random chance.

#### F. Summary of Market Loss Calculations

48. The table below summarizes my calculations of market loss for the Spoofing Sequences using both the But-For cost of trading approach and the alternative rate of spread-crossing approach. I have also provided a breakdown of market loss attributable for each trader:

Trader	Unadjusted Market Loss	Adjusted Market Loss (with But-For Cost of Trading)	Alternative Adjusted Market Loss
Gregg Smith	\$102,930,710	\$81,153,519	\$47,799,170
Christian Trunz	\$7,869,665	\$6,434,245	\$3,654,531
Michael Nowak	\$7,668,640	\$6,234,010	\$3,561,178
John Edmonds	\$680,615	\$509,160	\$316,065
Gregg Smith & Michael Nowak	\$319,560	\$270,427	\$148,398
Gregg Smith & Christian Trunz	\$90,765	\$190,210	\$42,150
Gregg Smith & John Edmonds	\$3,730	\$3,158	\$1,732
Michael Nowak & Christian Trunz	\$33,800	\$1,937	\$15,696
Michael Nowak & John Edmonds	\$2,430	-\$10,670	\$1,128
John Edmonds & Christian Trunz	\$9,800	-\$11,050	\$4,551
<b>Total</b>	<b>\$119,609,715</b>	<b>\$94,774,945</b>	<b>\$55,544,600</b>

<sup>33</sup> A pairwise t-test tests whether the average difference in spread-crossing rates before and during each Spoofing Sequence is statistically different from zero.

Trader	Unadjusted Market Loss	Adjusted Market Loss (with But-For Cost of Trading)	Alternative Adjusted Market Loss
Trades during the Spoof Duration			
Gregg Smith	\$103,025,205	\$81,346,887	\$47,843,052
Michael Nowak	\$7,704,870	\$6,225,277	\$3,578,003
Gregg Smith & Michael Nowak	\$319,560	\$270,427	\$148,398
Trades within the minimum of [Spoof Duration, 30 seconds]			
Gregg Smith	\$91,993,730	\$69,213,774	\$43,666,066
Michael Nowak	\$6,640,680	\$5,113,399	\$3,152,088
Gregg Smith & Michael Nowak	\$304,210	\$253,399	\$144,397
Trades within the minimum of [Spoof Duration, 10 seconds]			
Gregg Smith	\$69,251,765	\$44,763,380	\$34,416,315
Michael Nowak	\$3,994,170	\$3,042,085	\$1,984,998
Gregg Smith & Michael Nowak	\$98,080	\$90,294	\$48,743
Trades within the minimum of [Spoof Duration, 5 seconds]			
Gregg Smith	\$51,854,785	\$30,629,411	\$26,708,246
Michael Nowak	\$2,408,030	\$1,839,274	\$1,240,276
Gregg Smith & Michael Nowak	\$40,530	\$31,084	\$20,875

### G. Additional Components of Market Loss

49. The methodologies I used to quantify the market harm attributable to the Spoofing Sequences likely understate total market harm for the following reasons:
- I only calculate the loss incurred by market participants on the Spoof Order side for their orders that were executed while the Spoof Orders are active. Put simply, even after a Spoof Order is canceled, it can take time for the market to return to its prior state. However, I did not attempt to capture the potential lingering effect of the Spoof Orders after they are canceled, when market participants may still be responding to the pressure created by the Spoof Orders.

- For example, Mr. Smith's Episode #24a, which is the 60-second zoom out chart for Mr. Smith's Episode #24 of GX 450, illustrates the extent to which market participants may have been harmed by Mr. Smith's Spoof Orders even though they traded after Spoof Orders had already been canceled. In the 60 seconds after Mr. Smith canceled his group of 10-lot orders, the best bid price remained elevated above what the best bid price was prior to the placement of his group of 10-lot orders. While the best bid price after the Spoof Orders are canceled remains elevated above what it was prior to the placement of the Spoof Orders, my calculation only incorporates the losses incurred during the life of the Spoof Orders and does not account for losses that occurred following the cancellation of the Spoof Orders.
  - Mr. Smith's Episode #66 of GX 450 similarly illustrates the potential lasting effect of Spoof Orders that is not captured by my methodology. During the episode, Mr. Smith places three groups of 10-lot sell orders. While the best offer price remains lower than what it was prior to the placement of Mr. Smith's first group of 10-lot sell orders, I only calculate losses during the life of the Spoof Orders. Therefore, my calculation does not include any losses that occurred between the three groups of 10-lot Spoof Orders when the best offer price remained below what it had been prior to the placement of Mr. Smith's first Spoof Orders in this episode.
- b. I only calculate the loss incurred by market participants on the Spoof Order side for their orders that were executed. I do not account for orders that were resting on the Spoof Order side before the Spoof Orders were placed and that subsequently lost the opportunity to get fills due to the pressure created by the Spoof Orders. While Spoof

Orders are active, the price is likely to move “away” in response to the spoofing pressure (*i.e.*, move higher for buy-side Spoof Orders and move lower for sell-side Spoof Orders). Therefore, resting limit orders on the Spoof Orders side are less likely to get fills. My analysis does not attempt to quantify this opportunity cost of non-execution for these orders.

- c. In calculating market loss only during Spoofing Sequences, I did not quantify the long-term effects of spoofing activity on financial markets. More broadly, and as I have previously testified, the practice of spoofing degrades market integrity by causing a loss of confidence among participants. Traders factor in the risk of being cheated by reducing participation or withdrawing from the market, which has the potential to hurt market liquidity by decreasing the pool of available counterparties with whom to trade. False information on demand and supply lowers the market participant’s confidence that the observed futures prices are accurate. Thus, the practice of spoofing degrades the two primary functions of financial markets – liquidity and price discovery.<sup>34</sup> In other words, the Spoofing Sequences have lasting detrimental effects far beyond the periods covered by Defendants’ Spoofing Sequences and I have not attempted to quantify such an effect.
- d. I do not consider other non-futures markets where prices correlate with precious metals futures, such as exchange-traded funds (“ETFs”), options, or individual stocks whose performance is directly tied to precious metals.

---

<sup>34</sup> See Trial Transcript, pp. 2717, 2811.



Pursuant to 28 U.S.C. § 1746, I, Kumar Venkataraman, certify under penalty of perjury that the foregoing is true and correct.

Krushna Kumar 19

Kumar Venkataraman, PhD

# Exhibit 5

**UNITED STATES DISTRICT COURT  
FOR THE NORTHERN DISTRICT OF ILLINOIS  
EASTERN DIVISION**

UNITED STATES OF AMERICA,	)	
	)	
	)	No. 1:19-CR-00669-1, 2
	)	
v.	)	
	)	Judge Edmond E. Chang
	)	
	)	
GREGG SMITH and MICHAEL NOWAK	)	
	)	

**ORDER**

This Order explains the loss-amount calculations under Sentencing Guideline § 2B1.1(b)(1).

**Scope of the Jointly Undertaken Activity**

On deliberation of the arguments discussed at the initial sentencing hearing, and based on the trial evidence and testimony, the Court concludes (as previewed during the hearing) that each Defendant is responsible for only the loss amounts arising out of their individual spoofing sequences. Although the question is very, very close, the government has not shown by a preponderance of the evidence that each Defendants’ and each cooperators’ conduct was part of “jointly undertaken criminal activity.” Guideline § 1B1.3(a)(1)(B)(i).

The government argues, certainly with some basis, that Defendants Gregg Smith and Michael Nowak, along with John Edmonds and Christian Trunz (two co-operators, jointly undertook the spoofing on the JPMorgan Precious Metals Desk, so all are responsible for each other’s spoofing. It is most certainly true that the government proved a *conspiracy* amongst those four to spoof. The Court credits (as apparently did the jury) the testimony of John Edmonds and (especially) Christian Trunz in establishing that they learned how to spoof from Smith (and Edmonds also learned from watching Nowak), and even that the expectation was to spoof when Smith was away from his station. Plus, the four had a joint motive for the Precious Metals Desk to succeed for their clients.

But application note 1 to Guideline § 1B1.3 explains that the “principles and limits of sentencing accountability under this guideline are not always the same as the principles and limits of criminal liability.” § 1B1.3, appl. n.1. The scope of jointly undertaken criminal activity is “not necessarily” the same as the scope of an entire conspiracy. *Id.*, appl. n.3(B). When assigning vicarious responsibility in this context, “the focus is on the *specific* acts and omissions” for which the defendant is proposed to be responsible, “rather than on whether the defendant is criminally liable as a ... conspirator.” *Id.*, appl. n.1 (emphasis added).

It is one thing to conspire; the Defendants and the coconspirators here did that. It is another thing to jointly undertake every spoof on the Precious Metals Desk. The proof fell short on showing that. It is much easier to find that a criminal undertaking covers all of the Defendants (and all of the misconduct) in a case when the *entirety* (or nearly all of it) of the undertaking is criminal in *nature*. For example, acts in furtherance of a drug-dealing conspiracy or a Ponzi fraud scheme are much more readily attributed to all defendants because that is the nature of the undertaking: to commit crimes. The same cannot be said of the Precious Metals Desk. As frequently as each of the Defendants and cooperators committed spoofing over the years, the Desk was not merely a vehicle to commit crimes (and the jury sensibly rejected the RICO conspiracy charge, which would have required deeming the Desk as a criminal enterprise). So, yes the evidence proved a conspiracy, but no the evidence falls short of attributing every spoof to every Defendant or cooperator. The loss amounts shall be individually calculated.

### **Loss-Amount Methodology**

To determine the Guidelines actual-loss amount, the task is to find the “reasonably foreseeable pecuniary harm that resulted from the offense.” Guideline § 2B1.1, appl. n.(A)(i). The government of course bears the burden of proving the loss amount by a preponderance of the evidence, “but a reasonable estimate will suffice.” *United States v. Gumila*, 879 F.3d 831, 834 (7th Cir. 2018).

Here, the government’s proposed loss-calculation methodology, as fashioned by expert witness Professor Kumar Venkataraman, is generally sound and provides a reasonable estimate. As this Order explains, there are specific reasons to reduce the ultimate loss calculation, but the *overall* approach is reasonable in the first instance. Venkataraman’s overall approach is designed to remove the usual effects of non-spoofed market movement. Of the two methodologies that Venkataraman set forth in

his declarations, the government proposed the more conservative (that is, the methodology that generates the lower loss amount). R. 856 at 19. The label attached to the more-conservative methodology is the “Alternative Adjusted Market Loss.” Venkataraman Initial Decl. at 24 ¶ 39; *see id.* ¶¶ 40-47.

Before getting to the “adjusted” part of the Alternative Adjusted Market Loss methodology, the first step of the computation is almost the same as the methodology approved by the district courts in *United States v. Bases*, 18-CR-0048 (Lee, J.), and *United States v. Vorley*, 18-CR-0035 (Tharp, J.). (The “almost” caveat is explained in a moment.) The government’s expert examined “Spoofing Sequences” committed by the Defendants, with those sequences defined by the following:

- ▶ a resting, fully displayed group of orders (where “group” comprises orders of the same lot size on the same side of the market placed within one second of each other), with a smaller limit order (or orders) on the opposite side of the market. The resting orders are the Spoof Orders, and the opposite-side orders were labelled the Opposite Orders.
- ▶ Spoof Orders are confined to those that the Defendant placed in groups within the Top 10 levels of the order book and for the same lot sizes placed by the Defendant for the trial-evidence orders. The Top 10-placement is in contrast to *Vorley* and *Bases*, where the Spoof Orders were confined to the Top 5 levels of the order book.
- ▶ Opposite Orders are confined to those that the Defendants placed in the Top 10 levels of the order book.
- ▶ Sequences were deemed as Spoofing Sequences even if limit orders were on both sides of the market so long as the large-side aggregate quantity was at least twice as large as the small-side aggregate quantity.

R. 856-1, Venkataraman Initial Decl. at 9 ¶ 16. In the Venkataraman’s *updated* calculation, Spoof Orders were confined (or, from the defense’s perspective, allowed) to those that were left open for no more than 36.165 seconds for Defendant Smith and 34.875 seconds for Defendant Nowak. R. 873-1, Venkataraman Reply Decl. at 22–23 ¶ 27. Those respective maxima were based on the longest-open orders presented at trial to the jury.

As a first step, this is all a reasonable way to start calculating the loss caused by the Defendants' spoofing. As the evidence at trial demonstrated repeatedly, when the Defendants placed large, visible orders that created an imbalance with the opposite of the market, frequently the price was pushed to the opposite side—thus filling the orders that the Defendants wanted to fill. The Defendants then cancelled (almost always successfully) the large-side orders. The jury found beyond a reasonable doubt (and the Court agrees with the finding) that the large-side orders were in reality placed with the unconditional intent to cancel them, because the Defendants entered the orders to trick the market into believing that there was a genuine supply or demand represented by the orders—that is, the spoof orders. Some of the defense objections continue to resist what was established at trial, such as that the Spoof Orders could have been placed to discover price or liquidity, but the persistent pattern of trading showed otherwise, and the generalized, legitimate trading stratagems do not provide a rational, economic reason for what the Defendants did.

It is true, as the defense argues, that the bulk of the trial evidence presented much faster cancellations—that is, shorter durations—for which the spoof orders were open in the market, when compared to the maximum durations that Venkataraman allowed to qualify as a Spoof Order. But as noted above, Venkataraman did rely on the trial evidence to set the maxima, using the longest durations that the respective Defendants left open in the trial-evidence sequences. R. 873-1, Venkataraman Reply Decl. at 22–23 ¶ 27 (36.165 seconds for Smith and 34.875 seconds for Nowak). Yes, those maximum durations are significantly longer than what would result from the super-fast-cancellation clicking that formed the core (and the most colorful part) of the trial evidence of Spoof Orders. But that does not alter the fact, certainly proven by a preponderance, that even the half-minute or so cancellations represented cancellations that would otherwise make no economic sense and did not incorporate anything that happened post-placement that the Defendants were taking into account. The market moved very, very fast but the lightning-fast *algorithms* pushed the pace to milliseconds placements and cancellations; nothing other than spoofing persuasively explains what the Defendants were doing even at the 34-second or 36-second durations. No doubt that human traders can process information very quickly, and even five seconds might very well be enough time—in the ordinary course—to make a decision to cancel. But even with the longer durations as a parameter, the *median* orders (across the Defendants and cooperators (and admitted-spoofers) Christian Trunz and John Edmonds) were open for only 1.5 seconds, compared to 12.8 seconds for Opposite Orders. R. 856-1, Venkataraman Initial Decl. at 12 ¶ 20. And the other key features (discussed next) of spoofing in the Spoofing Sequences

support the reliance on the maximum durations proposed by Venkataraman (in his updated calculations). In light of these circumstances, the defense's proposed alternatives of much shorter durations for the Spoofing Sequences is rejected.

Indeed, the other key features of spoofing were incorporated into Venkataraman's methodology. The Spoofing Sequences need not fit *exactly* the trial-evidence sequences; instead, the *key* features should (and do) remain intact: the Defendants placed large, visible orders that imbalanced the market and were quickly cancelled after the filling of the small-side (genuine) orders, with no apparent (or unapparent) economic rationale for the quick placement-and-cancellation. Even at the Top 5 levels (more on this below), the Spoofing Orders created a substantial market imbalance, on average almost 2:1 when comparing the Spoof Side with the Opposite Side. *See* R. 873-1, Venkataraman Reply Decl. at 5 ¶ 14(ii), *see also* R. 856-1, Venkataraman Initial Decl. at 11 ¶ 19. And the methodology still displayed a low fill ratio for proposed Spoof Orders of 2.6%, compared to a 40.1% fill ration for Opposite Orders, R. 856-1, Venkataraman Initial Decl. at 12 ¶ 20. The set of overall parameters for Venkataraman's methodology is sound (again, with the exception of relying on the Top 10 levels rather than some part of the Top 5, as explained below).

The government (through Venkataraman) then further reduced the loss calculation by taking into account the fact that even *absent* Spoof Orders, market participants sometimes do cross the spread (the gap between the best offer and the best bid) in either direction. This reduction in the loss calculation thus tried to remove those trading costs that in effect would have been incurred anyway, even without Spoof Orders. Here again Venkataraman chose a reasonable method: he calculated the rate of spread-crossing for a matched (that is, the same time duration) control period immediately *leading up* to the Spoofing Sequence and compared it to the rate of spread-crossing *during* the Spoofing Sequence. R. 856-1, Venkataraman Initial Decl. at 25 ¶¶ 39–40, 42. This reduction rebuts the defense argument that Venkataraman's methodology measured correlation, rather than causation.

Although the overall methodology and overall set of parameters were sound, the defense experts (Dr. Mukkaram Attari and Mr. Jerry Cusimano) did pose valid objections to five specific subcategories of Spoof Orders that Venkataraman had included in his initial calculation. Venkataraman recalculated the loss amount to account for the five objections.

First, the experts objected that the government had included Opposite-Side Orders that were resting some 20 price levels away from Spoof Orders. In total, those represented around 6% of the Spoofing Sequences (the 6% equaled 7,949 sequences). R. 873-1, Venkataraman Reply Decl. at 44 ¶ 69. Venkataraman updated the calculation to remove those 20-level-plus sequences. *Id.*

Next, Dr. Attari noted a non-standard value in the trade data (the RAPID data set in particular), and when Venkataraman went back to exclude all sequences with that non-standard value, 60 more Spoofing Sequences were removed (around 0.05% of the total) from the calculations. R. 873-1, Venkataraman Reply Decl. at 45 ¶ 70.

Third, the defense experts pointed out that during some of the Spoofing Sequences, a convicted spoofer (Edward Bases, James Vorley, Cedric Chanu, or John Pacilio) had placed orders in the market at the same time. R. 873-1, Venkataraman Reply Decl. at 45 ¶ 71. So Venkataraman excluded the 2,956 sequences (around 2% of the total) in which another spoofer had placed orders. *Id.*

The fourth objection was the maximum duration of the Spoofing Sequences, which Venkataraman initially allowed to be as long as 82.3 seconds. R. 873-1, Venkataraman Reply Decl. at 45 ¶ 72. As explained above, the updated version limited the maximum durations based on the trial evidence and circumstances. R. 873-1, Venkataraman Reply Decl. at 22–23 ¶ 27 (36.165 seconds for Smith and 34.875 seconds for Nowak); *id.* ¶ 72. Reducing the maximum durations to the trial-based durations resulted in removing 3,009 Spoofing Sequences (around 2% of the total). *Id.*

Fifth and finally, Venkataraman updated the loss calculation to exclude those sequences in which there was a large, resting non-iceberg Opposite-Side order, specifically a resting Opposite-Side order that was greater than either half of the aggregate quantity on the Spoof-Order side (which varies depending on the commodity) or the largest non-iceberg Opposite-Side order placed by the particular Defendant based on the trial evidence. R. 873-1, Venkataraman Reply Decl. at 46–47 ¶ 73. That ended up excluding another 1,157 sequences (0.87% of the total). *Id.* at 46 ¶ 73. All told, the updated calculation removed 14,594 sequences, leaving 117,621 Spoofing Sequences (of which Smith accounted for 94,532 and Nowak committed 5,023). *Id.* at 48 ¶ 74. The Updated loss figure, using the spread-crossing methodology, assigned a loss of \$33,251,793 to Smith and \$2,329,944 to Nowak. *Id.* at 51 ¶ 80.



After accounting for those five specific objections, the defense's other critiques (including the additional quibbles set forth in the defense's supplemental declarations) do not undermine the fundamental reasonableness of Venkataraman's approach to arrive at a reasonable *estimate* (which, after all is the task at hand). But there is one exception. As forecast earlier, in *Bases*, Venkataraman limited the Spoof Orders to those that were placed in the Top 5 levels of the order book, whereas in this case he extended the Spoof Orders to cover those placed in the Top 10 levels. As the Court noted at the first sentencing session, Venkataraman testified at trial that the Top 5 levels tend to reflect the orders of the most interested market participants. And, not surprisingly, he also explained at trial that bids and offers placed in those levels are more likely to have an impact on the market. So, to the extent that Venkataraman included as layered Spoof Orders those orders that were not layered *at all* in the Top 5 levels, the proof falls short of considering those to be instances of spoofing.

Having said that, Venkataraman and the government are correct that the loss amount should include those sequences when the Defendants layered Spoof Orders with *at least one* of the layered orders being placed in the Top 5 levels. That is still consistent with the intended effect of falsely signaling to the most interested market participants that there is a genuine bid or offer, and particularly so given the other key features of spoofing are present. This is the right balance to be struck: so long as *one* of the layered Spoof Orders was placed in the Top 5 levels (as measured at time of placement), even if some other orders were played outside those levels, then the orders still qualify for a Spoofing Sequence.

The result is, then, that Smith's loss amount of \$33,251,793 is reduced by 72% to **\$9,310,502**. This reduction is based on the record evidence available, namely, Dr. Attari's calculation that "using the top 10 levels rather than the top 5 levels allows Dr. Venkataraman to increase his Unadjusted Market Loss by 72%." R. 879-2, Attari Suppl. Decl. at 10 ¶ 13. This figure might actually reduce the loss amount by too much if Attari was limiting the Spoofing Sequences to those that had orders *only* in Top 5 levels, but it is the best record evidence on hand. For Nowak, Mr. Cusimano calculated the loss (based on the criterion that only one layered order had to be in the Top 5 levels) at **\$2,288,940**, R. 907-1 at 2 ¶ 1 (which is not material different from the government's supplemental figure, R. 906-1).

Lastly, the only other defense objection (most thoroughly presented at the initial sentencing session) that gave the Court some pause was Cusimano's assertion that Venkataraman had mistakenly overstated the length of time that the Spoof

Orders could possibly have had a price impact. Cusimano contends that the rate of spread-crossing must be measured in both directions, not just one, and that accounting for both directions would show that the price impact of the Spoof Orders dissipated faster than what Venkataraman asserted. On deliberation, however, there is no record evidence to support a connection between the two directions of spread-crossing such that this factor must be accounted for. Just because, for example, a buyer crosses the spread *upward* in price to reach a seller, does not mean that sellers on the other side would be crossing the spread *downward* in price to reach buyers. This is not a flaw in Venkataraman's methodology.

It is worth saying here at the end of the loss analysis where this all started: the assignment to calculate the Guidelines loss amount is to arrive at a reasonable *estimate* of the loss by a preponderance of the evidence. The task is *not* to achieve precision of calculation to a certainty. The government has shown that Smith's loss amount is **\$9,310,502**, corresponding to an 18-level increase under the fraud-loss table, Guideline § 2B1.1(b)(1). Nowak's loss amount is **\$2,288,940**, which is a 16-level increase.

ENTERED:

s/Edmond E. Chang  
Honorable Edmond E. Chang  
United States District Judge

DATE: August 21, 2023